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AN ACCOUNT OF SOME KJŒKKENMŒDDINGS, OR SHELL-HEAPS, IN MAINE AND MASSACHUSETTS.

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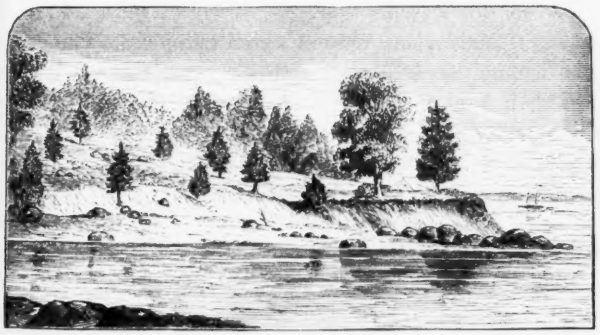

Crouch's Cove, Casco Bay, Maine.

Any one who would take the trouble on going to a strange city, to examine the rubbish in its suburbs and streets, and carefully collect and compare the fragments of pottery, pieces of cloth, of paper, cordage, the bones of different animals used as food, worked pieces of stone, wood, bone, or metal, might gain some insight into the

modes of life of the inhabitants, and form a fair conception of the progress they had made in the arts of civilization. Even after a city has become a ruin, and centuries have passed by, such examinations have been attended with fruitful results. A savage tribe, dwelling for a long period on one and the same place, would inevitably leave vestiges of the manner in which they lived, though these would, of course, be fewer in kinds just in proportion as the people were nearer to a primeval condition.

The former dwelling-places of the Aborigines of the United States are nowhere more plainly indicated than along the seaboard, where some of the tribes passed a portion, at least, of each year, in hunting and fishing; some no doubt living there permanently, while others, it appears, made visits only at stated periods.* The clam, the quahog, the scallop, and the oyster, entered largely into their food, and the castaway shells of these, piled up in many years, have not only become monuments of their sea-shore life, but have largely aided in the preservation of the bones of the animals on which they fed, and also of some of the more perishable implements used in their rude arts.

The shell-heaps on the Atlantic coast long since attracted notice. Dr. C. T. Jackson, and afterwards Professor Chadbourne, visited the remarkable one at Damariscotta, in Maine; Sir Charles Lyell has particularly described another on St. Simon's Island, in Georgia,† and quite recently Mr. Charles Rau, of New York, has given a full and instructive account of the examination of another at Keyport, New Jersey.‡ We have ourselves

*"Quand les sauvages vont a la mer pour y passer quelques mois a la chasse des canards, des outards, et des autres oiseaux qui s'y trouve en quantite," etc. Lettres du P. Sebastian Rasles a Narantsook ce 25 Oct., 1722. Lettres Edifiantes, Paris, 1838.

†Second Visit to the United States. New York, 1849. Vol. I. p. 252.

‡Smithsonian Report, 1864, p. 370.

examined two on the sea-coast of East Florida, and still others in considerable numbers on the banks of the upper St. John's, in the same State. These last-mentioned heaps consist wholly of the shells of fresh-water species. We may have something to say of them hereafter, but at present shall only speak of such as were visited on the coast of Maine and Massachusetts during the summer and autumn of the year just past. Of the localities where these are situated, and of the structure of the heaps, we shall speak as briefly as possible; but shall enter somewhat fully into details, in connection with the implements and the remains of animals found in them. It is to be understood, however, that the heaps here described are only a very small portion of those to be seen along the coast of these two States, and which offer an ample reward to any who will take the trouble to examine them.

Frenchman's Bay. Mount Desert is the largest of the islands on the indented coast of Maine, and forms the western shore of Frenchman's Bay. Many shell-heaps are scattered over this and the adjoining islands and the main land. Williamson,* without particularly designating them, mentions the existence of several from one to two acres in extent, and states that "a heavy growth of trees was found upon them by the first settlers." We have examined two. The first of these is in Gouldsboro', on the main land, and near the water's edge on the eastern shore of the bay. It is said to cover an acre of land, but being under cultivation was examined only near its border, where a pit was sunk showing a deposit of clam-shells about two feet in thickness. Among these were found the bones of several animals, including those of the

*History of the State of Maine. Hallowell, 1832. Vol. I. p. 80.

deer, elk, and beaver, but no implements of any kind. Stone implements have, however, been found by those who have cultivated the soil of this neighborhood.

A more complete examination was made of a second deposit on one of two small islands, neither of which are named, about a mile west of the place just mentioned.* This heap is seen on a bank, at a height of about six feet above the high-water mark, varies in thickness from a few inches to about three feet, and extends along the shore about two hundred and fifty feet, and from thirty to forty feet inland. A section through the heap at its thickest part showed that it belonged to two different periods, indicated by two distinct layers of shells. The lowest, a foot in thickness, consisted of the shells of the clam, whelk, and mussel, all much decomposed, and mixed with earth. Above this was a layer of dark vegetable mould, mixed with earth and gravel, and from six to eight inches in thickness. Above this was a second layer of shells, of the same species as those just mentioned, but in a much better state of preservation, and with less intermixture of earth; this deposit was in turn covered by another layer of earth and mould, and these now sustain a growth of forest trees, but none of them of large size. From the state of things just described, it would seem that the place had been reoccupied, after having been once abandoned long enough for a vegetable mould to be formed, and a layer of earth from some neighboring source to be deposited over it. Charcoal was found in considerable quantity, scattered among the shells, and the remains of an old fireplace were uncovered. The bones of animals, and the various kinds of implements (Pl. 14, figs. 3, 4,

*The two heaps were examined in company with Dr. Calvin Ellis, Messrs. John L. Hayes, William A. Hayes, and R. E. Fitz, to whom the writer is indebted for valuable specimens found by them.

5; Pl. 15, figs. 10, 11) obtained during the excavations, will be described in another page.

Crouch's Cove. This is situated on Goose Island, in Casco Bay, about fifteen miles north-east of Portland. The whole island is at present covered with a growth of spruce trees (*Abies nigra*), excepting a narrow strip on the seaward side, and on this, at the southerly end of the island, are several shell-heaps of different sizes. The longest of these is about one hundred and fifty feet in length, forty in width, and varying in thickness from a few inches to nearly three feet. Considerable portions have been washed away, and the contents scattered along the shore. The shells are mostly deposited evenly, but here and there are raised into small knolls, and all are covered with turf. This deposit has been carefully examined by Mr. C. B. Fuller, of Portland, by whom large collections have been made, and a portion of which were unfortunately destroyed by the great fire of 1866. Mr. Edward S. Morse has more recently made a partial examination, and obtained many valuable specimens, which will be mentioned farther on.

Our examinations* were begun on the bank and carried inland, until about 375 square feet of surface, and more than 700 cubic feet of material had been moved. Mr. Morse has given the following account of the shells found in this, and some of the smaller deposits near by. He enumerates the following species: "Common Clam (*Mya arenaria*), Quahog (*Venus mercenaria*), Large Scallop (*Pecten tenuicostatus*), Large Mussel (*Mytilus modiolus*), Cockle (*Purpura lapillus*), Beach Snail (*Natica heros*), Whelk (*Buccinum undatum*), Periwinkle (*Littorina lito-*

*The excavations were made by Rev. J. A. Swan, and Messrs. E. S. Morse, F. W. Putnam, Horace Mann, Edwin Bicknell, and the writer. The sketch of the locality was made by Mr. Joseph P. Thompson.

ralis); and also the following, for which there are no common names: *Nassa obsoleta*, *Natica triseriata*, and *Macoma fusca*. The following land snails were also met with: *Helix albolabris*, *Sayii*, *alternata*, *lineata*, *striatella*, *indentata*, *multidentata*, *Zua lubricoides*, and *Succinea Totteniana*."

"The heaps were almost entirely composed of the shells of the common clam, which appeared longer and rougher in texture than that now dug near by. In some of the heaps the shells of the quahog were abundant, and marked for their size and solidity. This species, though no longer found in the same cove with the heaps, may be had in the neighborhood of Goose Island, but localities in which it lives are quite rare north of Cape Cod. The common mussel, whelk, cockle, and scallop, were probably used as food, while the other species were doubtless carried there by accident. The presence of so many species of land snails would seem to indicate that the island was once covered with hard-wood trees, among which these animals alone flourish. The occurrence of the little snail, *Zua lubricoides*, is inconsistent with the view that it is an introduced species."

The shells were deposited in two different layers, very much as on the island in Frenchman's Bay already described. The older was separated from the more recent deposit by a thin stratum of earth, extending through the largest portion of the heaps. Pieces of charcoal were scattered everywhere among the shells, but in some places the larger quantity and the blackened earth showed where fires had been made. The number of the fragments of the bones of edible animals was quite large, belonging to no less than fifteen species. Besides these, many bones of other species, bone implements (Pl. 14, figs. 1, 2; Pl. 15, figs.

6, 7, 8, 9, 12, 13), and pieces of bone from which portions had been sawed off were found; no implements of stone were exhumed, though Mr. Swan found a small pestle, and Mr. Morse a chisel lying on the surface near the shore.

A third deposit was examined at *Eagle Hill*, in Ipswich, Massachusetts, situated on the borders of a creek, by which easy access is had to the sea-shore. The whole neighboring region consists of a series of low hills of gravel, some of them covered with boulders, but entirely destitute of forest trees. A few basswood trees (*Tilia Americana*) have been known to exist there within a few years, but otherwise those hills do not appear to have been wooded within the memory or traditions of the present inhabitants. Several shell-heaps are reported to exist in the neighborhood, but the only one examined was on the easterly side of the hill mentioned above. This consists of several disconnected deposits of shells, which are in part spread out into a uniform layer, but in a few instances form small knolls from eight to ten feet in diameter. Near the water's edge the shells are exposed by the washing away of the bank, but elsewhere are covered with mould and turf, and, in some places, even on the knolls, with a layer of gravel. In the more even portions, this last may have been washed down from the slopes above, but such could not have been the case with the knolls, for the tendency would have been to denudation rather than to covering up. The shells, forming these deposits, are almost exclusively those of the common clam, which are still found here in great quantities, and yield a considerable revenue to those engaged in digging them. Large piles of recently dug shells may be seen along the neighboring shore, and noticeably contrast with those from the Indian shell-heaps, in being thinner and

less rough in their texture. Shells of the oyster and the Mactra were found, but few in number. Somewhat extensive excavations* yielded bones of the deer, beaver, dog, birds, among these the bones of the turkey, and of fish; but only a single implement of stone, which was spherical in shape, with a groove around the middle of it. This was found by Mr. Putnam just beneath the surface. Some of the bones showed distinct marks of cutting instruments, and a few pieces of wrought bone were found, three of which are represented in Pl. 15, figs. 15, 16, 17. Two distinct fireplaces, indicated by hard-wood charcoal, ashes, and blackened earth were found, resting on the earth and beneath the shells.

In the town of *Salisbury*, Massachusetts, a series of heaps thirteen in all, quite near together, consisted exclusively of the shell of the clam. They are about a mile from the left bank of the Merrimack River, near its mouth, and surrounded by a series of sand-downs, some wooded, others naked; these last constantly changing from the action of the wind. They vary in size from about twenty to more than one hundred feet in diameter, but the shells form a layer of only a few inches, and are largely mixed with sand. After a careful search, in company with Mr. Alfred Osgood, of Newburyport, we failed to find in most of them any of the works of man, except only a few flakes or "chips" of flint; but on two, both near together, large quantities of chips were scattered over the surface, and more than five pounds were picked up. Besides these, several arrow-heads and fragments of pots, made of burned clay mixed with coarse sand, were found. No bones of animals, which might have served for food, were noticed, though carefully looked for. In previous years,

*Made by Messrs. E. S. Morse, F. W. Putnam, C. Cooke, and the writer.

large numbers of stone implements of various kinds have been carried away; but as the place is in the neighborhood of a large town, and is frequently visited by those in search of such relics, they are now nearly exhausted.

Cotuit Port is in the town of Barnstable, on the south side of Cape Cod, and on the northern shore of a narrow bay. It is quite near to the sea, but protected from it by a narrow spit of land, which forms a natural breakwater across the bay at its mouth. Within the distance of a few miles, a large number of shell-heaps are met with, and have been estimated to cover hundreds of acres, sometimes having a thickness of between one and two feet, and at others of only a few inches. Oysters were formerly found in the bay in much larger quantities than at present, and doubtless formed one of the chief attractions which drew the Indians to this place. Our examinations were confined chiefly to one of the larger deposits, about a mile to the eastward of the village, situated on a sloping surface with a pleasant southerly exposure. Excavations by four persons during a whole day were made near the shore, and at various points inland, and brought to light the shells of the oyster, clam, scallop, and quahog, in large numbers, but quite unequally distributed; the clam being plentiful in some places, the quahog in others, and the scallop in others, while the oyster abounded everywhere.

Two species of *Pyrula*, viz.: *P. carica* and *P. canaliculata* were found, the first in considerable numbers. Neither of these species was found in any of the other heaps. Dr. Gould states that they are not known to exist north of Cape Cod. The largest specimen of the *P. carica* was about seven inches in length, a portion of the spire having been broken off, and this, according to Dr.

Gould, is their maximum size on the Coast of Massachusetts. It is, however, in remarkable contrast with a shell of the same species from one of the shell-heaps in Florida, which measured nearly fourteen inches in length.

Of the remains of vertebrates, the bones of the deer were the most abundant; but those of the seal, the fox, the mink, of birds, including those of a duck and the wild turkey, of turtle and of fish were found. During a former examination of this locality by Mr. George G. Lowell and Dr. Algernon Coolidge, a canine of a bear and a part of the skull of a cat was obtained. No stone implements, but a few worked pieces of bone were dug up, and also some fragments from which portions had been sawed off. The tine of a deer's antler, from which the tip had been sawed off, is represented on Pl. 15, fig. 14. About two-thirds of the metatarsal bone of the great toe from a human foot was found, in company with the bones of the animals already mentioned, and is the only portion of the skeleton of man which we have discovered while examining the heaps here described. The writer would express his obligations to Mr. George G. Lowell for the opportunity of examining the locality at Cotuit Port, and for the gift of valuable specimens.

Age. Shell-heaps have become intimately associated with the question of the age of the human race, a question which has passed out of the domain of the written, into that of geological history. It can only be satisfactorily answered by following the method of the geologist, when he attempts to determine the period when a given animal existed in former geological times, viz., by a careful comparison of the remains of such animal with those of existing species, and by an accurate study of the geological and other physical conditions under which they are found.

In Denmark, such methods applied to the *Kjækkenmœddings*, or refuse-heaps, have yielded results of great importance to archæology, and have shown that some of these heaps at least, as in Seeland along the Isefjord, date back to a period when their geological surroundings were somewhat different from what they now are, when the shores were less raised above the sea, and the oysters, of the shells of which the heaps are made up, had not yet retreated to where the fresher waters of the Baltic, at the present time, mingle with the ocean in the Kategatt.

The shell-heaps we have here described yield nothing which indicates as high an antiquity as those of the old world. The materials of them present some variety in the degree of decomposition which has resulted from time and exposure, the lower layers being much more disintegrated and friable, the shells in fact falling to pieces, while those of the upper ones generally preserve their original firmness. That there was a difference in time in which these layers were deposited, is further indicated by the fact, that, in two of the heaps, a stratum of earth is interposed between the earlier and later deposits, as if the locality had been abandoned as a camping place, and then after a prolonged absence of the natives had been reoccupied. Each heap, too, is covered with a deposit of earth and vegetable mould, of variable thickness, and in some cases, as at Frenchman's Bay, supporting a growth of forest trees, though these were nowhere of such size as to indicate that they had lived a century. Mr. Morse has called attention to the abundance of *Helices*, or land snails, which were exhumed at Crouch's Cove, and to the fact that these require a hard-wood growth for subsistence, while at present the island, on which this cove is situated, is covered with spruces. It is also noticeable

that there has been in all the localities, except at Salisbury, a disintegration of the shores, the sea undermining and destroying the deposits. There can be no doubt that these were once much more extensive than now, and that the water has worked its way into their places. Lastly, these deposits contain the remains of animals, as of the elk, not known at present to exist to the eastward of the Alleghany Mountains; of the wild turkey, now virtually extinct in New England; and of the great auk, which, unless it still live on some of the small islands to the north of Newfoundland, has receded almost, if not quite, to the arctic regions.

All these circumstances are certainly signs of the lapse of time. Nevertheless, in the absence of any positive data as to how long a period is necessary for the accumulation of vegetable mould, or for the washing of earth from the slopes above on to the heaps below, or for the rate of decomposition of shells in a given time, or of the rate of the denudations of the shores; and in view, too, of the fact that the animals represented in the heaps, but now no longer met with in the regions of them, have all disappeared within the historic period of this continent, it will be readily admitted that proof of great age or "high antiquity" is not found in any or all the circumstances which have been mentioned above.

On the other hand, it may be safely said that there is nothing in the condition of these heaps which is inconsistent with the hypothesis that they were begun many centuries ago. The examinations at Crouch's Cove, Eagle Hill, and Cotuit Port were sufficiently extended to enable us to obtain a fair representation of the objects they contain; but in no case was there found, nor have we been able to learn, that there had been previously found a

single article which could be regarded as having been made by, or derived from the white man, nor did we obtain any evidence that these particular heaps had been materially added to since the European has occupied these shores. Had intercourse with Europeans been once fairly established, it were a reasonable presumption that we should have found at least a glass bead, a fragment of earthenware, or an instrument of some sort indicative of the fact, especially when we bear in mind that it would be in just such places, where the savages collected around their fires and seething-pots to cook and eat, that such objects might be expected to be broken or lost. Finally, if the statements of Williamson on the authority of Johnson be correct, viz., that "a heavy growth of trees was found on them" (the deposits of clam-shells near Mount Desert) "by the first settlers," we have something like satisfactory evidence that their age could not have been less than between three or four centuries.

Remains of Animals. Human remains have not been found in the shell-heaps of Denmark, except in the case of casual burials, as of a shipwrecked sailor, or of burials from some other unusual occurrence, and these are of a modern date. The same absence of human remains marks the shell-heaps we are describing, with a single exception. At Cotuit Port an unequivocal metatarsal bone from the great toe of the human foot was discovered. No other bones were found with it, except those of animals. It was so deeply buried, and its appearance was such, that no doubt exists that it was of the same age as the heap itself; we have therefore assigned it a place in the following table, which gives a list of the species of animals uncovered and identified by their bones, or shells, in the different heaps, and shows their relative distribution through them.

	Kinds of Animals found in the Shell-heaps.	Mount Desert.	Crouch's Cove.	Eagle Hill.	Cotuit Port.
1	Man,				*
2	Elk (*Cervus Canadensis*),	*			
3	Moose (*Alce Americanus*),	*	*		
4	Caribou (*Rangifer Caribou*),		*		
5	Deer (*Cervus Virginianus*),	*	*	*	*
6	Bear (*Ursus Americanus*),		*		*
7	Wolf (*Canis occidentalis*),	*			
8	Dog (*Canis*),	*		*	*
9	Fox (*Vulpes fulvus*),				*
10	Cat (*Felis*),				*
11	Otter (*Lutra Canadensis*),		*		
12	Mink (*Putorius vison*),		*		*
13	Sable (*Mustella Americana*),		*		
14	Skunk (*Mephitis mephitica*),				*
15	Seal (*Phoca vitulina*),	*	*		*
16	Beaver (*Castor Canadensis*),	*	*	*	
17	Woodchuck (*Arctomys monax*),	*			
18	Great Auk (*Alca impennis*),	*	*		
19	Razor-bill (*Alca torda*),	*			
20	Ducks (three species),	*	*		
21	Wild Turkey (*Meleagris gallopavo*),			*	*
22	Heron (*Ardea herodias*),		*		
23	Tortoise (two species),				*
24	Shark,				*
25	Cod (*Morrhua Americana*),	*	*	*	
26	Goose-fish (*Lophius Americanus*),		*		
27	Whelk (*Buccinum undatum*),	*	*		
28	*Pyrula carica*,				*
29	*Pyrula canaliculata*,				*
30	Oyster (*Ostrea edulis*),	*	*	*	*
31	Clam (*Mya arenaria*),	*	*	*	*
32	Quahog (*Venus mercenaria*),		*	*	*
33	Mussel (*Mytilus edulis*),	*	*	*	*
34	Scallop (*Pecten tenuicostatus* and *P. Islandicus*),		*		*
35	Hen-clam (*Mactra*),		*		

Besides the species of shells mentioned above, and which may be regarded as having been used for food, there were also found species from the following genera, probably accidentally introduced, viz.: *Tritonium*, *Littorina*, *Nassa Zua* and *Purpura;* seven species of *Helix;* three species of *Natica*.

A glance at the above table shows what a great variety of animals was brought to these places by the Indians.

Some were hunted as articles of food, others for their skin, and still others for both. Precisely where the line is to be drawn between those which are and are not edible, or what animal an Indian would absolutely refuse to eat, it is impossible to say. Although the kinds of meat used were in the main palatable, the natives certainly did not hesitate to make use of some which do not commend themselves to the taste of civilized people. Josselyn, who, of all the earlier writers, has given the most complete account of the animals found on the coast of New England, states that "the Indians, when weary with travelling, will take them (the rattlesnakes) up with their bare hands, laying hold with one hand behind their head, with the other taking hold of their tail, and with their teeth tear off the skin of their backs, and feed upon them alive, which, they say, refresheth them."*

The bones of the deer and birds outnumber those of all the other kinds. The condition in which they are found bears a striking resemblance to that of the bones from the shell-heaps of Scotland, the Orkneys, and Denmark. Nearly all the fragments from the *deer* were those of the long bones, which in the living animal are either covered by the largest amount of flesh, or contain the most marrow. Not one of them was whole, all having been broken up for the double purpose of extracting the marrow, a custom almost world wide among savages, and often practised by hunters, and of accommodating them to the size of the vessel in which they were cooked. Even the phalanges of the toes were treated in the same way.

The bones of the *bear*, though much less numerous, were similarly broken up, and in two instances had been carbonized by contact with the fire. Among the speci-

*New England's Rarities Discovered. London, 1672. p. 39.

mens collected by Mr. Morse in his first visit to Crouch's Cove, was the last molar from the lower jaw. The crown was somewhat worn, but the ridges were not all effaced; it was of small size, measuring 0.55 inch in length, and 0.46 in breadth. The average size of eight specimens of the same molar in the black bear was, length 0.60 inch, breadth 0.47, while that of two specimens from the polar bear was, length 0.54 inch, breadth 0.45. The tooth from the shell-heaps, therefore, as regards size, more closely resembles the last-mentioned species, as it does also in the shape of the crown,—but it would be unsafe, from a single specimen of the molar in question, to attempt to identify them. The former existence of the polar bear, on the coast of Maine, is rendered quite probable by the fact that the tusk of a walrus has actually been found at Gardiner.* Sir Charles Lyell obtained a portion of the cranium of another at Gay Head, Martha's Vineyard.† It was found by a fisherman who supposed that it had fallen from a cretaceous bed in the cliff above. Perhaps it may have been of a more recent date, and a contemporary of the Great Auk.

The presence of the bones of the *dog* might be accounted for on the score of its being a domesticated animal, but the fact that they were not only found mingled with those of the edible kinds, but like them were broken up, suggests the probability of their having been used as food. We have not seen it mentioned, however, by any of the earlier writers, that such was the case along the coast, though it appears to have been otherwise with regard to some of the interior tribes as the Hurons. With them, game being scarce, "venison was a luxury found only at

*Observations on the Glacial Phenomena of Labrador and Maine. By A. S. Packard, jr. Mem. Bost. Soc. Nat. Hist. Vol. I. p. 246.

†Travels in North America. New York, 1845. Vol. I. p. 205.

feasts, and dog flesh was in high esteem."* We have not found any marks of cutting instruments, as was the case with the bones found by Steenstrup in the shell-heaps of Denmark, and from which circumstance he inferred that dogs were eaten. In fact, they have served as food in so many parts of the world, that the use of their flesh anywhere ought not to be considered an improbability.

A whole left half of the lower jaw of a *wolf* was found at Mount Desert, measuring 7.5 inches in length, making a strong contrast in size, with a similar half from a dog found at Crouch's Cove. This was more curved, and had a length of a little less than five inches.

The bones of *birds*, like those of the deer, were almost without exception broken, but in quite a different manner. In the latter it was the shaft that was shattered, the ends often remaining uninjured; while in the birds the shaft was whole, and the ends not only broken off, but nowhere to be found. It is not to be supposed that they were so broken off for the extraction of the marrow, since those containing only air were treated in the same way. Steenstrup having observed the same fact in the remains from the Danish shell-heaps, suspected that they were mutilated by dogs, and accordingly by way of experiment, having kept some of these animals on short diet, gave them various bird bones to eat. He found, as he had anticipated, that they ate the ends, rejecting the shaft. He explains their choice by the greater sponginess, and easier digestibility of the former as compared with the dense middle portion of the latter. No doubt an additional inducement was found in the remains of flesh, tendon, and ligament, which would usually remain adherent to the ends, after the portions ordinarily eaten

* Parkman. Jesuits in America. Boston, 1867. p. 30.

had been removed. On looking over the specimens of our collections, marks of teeth of animals were frequently noticed, some of them of such size as might be made by dogs, but others by a much smaller animal, as a cat or mink.

Of the remains of birds, by far the most interesting are those of the Great Auk (*Alca impennis*), which formerly had a much wider geographical distribution than now, for having followed the glaciers in their retreat, at present it is confined to the arctic and subarctic regions. In Europe it formerly existed, as appears from the evidence of the shell-heaps, on the shores of Scotland, the Orkneys, and it has recently died out in Iceland. In the United States we have the authority of Steenstrup and Prof. Baird for its former existence as far south as Cape Cod. There can be but little doubt that the last survivors lingered till after the arrival of the Europeans. The description of the "Wobble," by Josslyn, as far as it goes, applies to the Great Auk, "an ill-shaped bird, having no long feathers in their pinions which is the reason they cannot fly; not much unlike a penguin."*

There are various traditions along the sea-coast of its having been seen at a much later date. Audubon, however, in his voyage to Labrador saw none in the Straits of Belle Isle, but was told that they still bred on an island north of Newfoundland.

The remains of the Great Auk in the shell-heaps of Maine, were in sufficient numbers to show that it must have been common, since seven specimens of the humerus alone were found, besides fragments of the cranium, jaws, and sternum. The specimens of humerus differed remarkably in condition from the same bone of other birds

*New England's Rarities Discovered, p. 11.

found with them, in not being mutilated; for of the seven specimens, four were whole, and the fifth had lost but one end, while of the humeri of the other kinds, scarce one was whole enough to enable one to identify the species. They seem not to have been attractive to the dogs. They are characterized by their much flattened shape, thick walls, narrow cavity, and the absence of an opening for the entrance of air. Well-preserved specimens of the coracoid bone were also found entire.

The catalogue we have given of the animals found in the shell-heaps shows that the elements of variety in food certainly existed, especially if we add to these the maize, beans, squashes, and various kinds of roots Indians are known to have used. From the testimony of eye-witnesses, soon after the settlement of the country, it appears that while sometimes the Indian contented himself with maize roasted, or with this and beans made into a pottage, he often, when the necessary materials were at hand, made what might well be called a hodge-podge. Gookin gives a full account of the manner in which this was concocted. In a word, it consisted of a mixture of fish and flesh of all sorts. "Shad, eels, alewives," "venison, beaver, bear's flesh, moose, otters, raccoons, or any kind that they take in hunting," are cut into pieces, bones and all, and stewed together. "Also they mix with said pottage several sorts of roots, as Jerusalem artichokes, and ground nuts, and other roots, and pompions, and squashes, and also several sorts of nuts or masts, as oak-acorns, chesnuts, walnuts. These, husked and dried and powdered, they thicken their pottage therewith."*

Father Rasles† expresses his disgust at their style of

* Historical Collection of the Indians of New England, in Collections of Massachusetts History Society. Boston, 1792. p. 150.
† Lettres Edifiantes et Curieuse. Vol. I. p. 670.

cooking and eating, and Wood evidently had a poor stomach for "their unoat-mealed broth, made thick with fishes, fowles, and beasts, boyled all together, some remaining raw, the rest converted by overmuch seething to a loathed mash, not half so good as Irish bonielapper."* When visiting the English, if offered food, Wood informs us they ate but little, "but at home they will eat till their bellies stand forth ready to split with fullness."*

Works of Art. *Pottery* is poorly represented, only small fragments having been found. Like those from other parts of the United States, the pots were made of clay, with or without the admixture of pounded shells, and were imperfectly burned so that the walls are both friable and porous. The ornamentation, when it exists, is of the rudest kind (Pl. 14, fig. 18), consisting of indentations or tracings with a single point, or, as in some cases, with a series of points on one and the same instrument. Both at Crouch's Cove and Cotuit Port, specimens were found in which the lines in the surface had been formed by impressing an evenly twisted cord into the soft clay (Pl. 14, fig. 19), the cord being laid on in various positions. This kind of ornamentation has a special interest, since there is evidence of its having been made use of in widely distant places. We have found similar specimens on the banks of the St. John's in Florida; there are others from Illinois, presented to the Peabody Museum by J. P. Pearson, Esq., of Newburyport, and others have been noticed in the ancient barrows of England.† This kind of ornament has given rise to the belief that the pots were moulded in nets, which were removed after the vessel was finished. All the specimens we have seen are wanting in

* New England's Discovered Rarities. London, 1635. p. 59.
† Prehistoric Times, by John Lubbock, 1865. p. 113.

any indication of a regular mesh, or of the existence of knots where the cords crossed, which, if they existed, as they must have in a net, could not have failed to be represented.

Implements. It is somewhat remarkable that with the exception of the shell-heaps at Salisbury, all of those here described yielded so few articles made of stone. At Mount Desert only two arrow-heads were found, at Crouch's Cove Mr. Swann found a pestle, and Mr. Morse a rude chisel, both picked up on the shore, but probably washed out from among the shells. At Eagle Hill, Mr. Putnam found a spherical stone with a groove around it, but at Cotuit Port not a single piece of worked stone was discovered. In regions adjoining the different shell deposits, especially at Cotuit Port, an abundance of stone implements have been found, and those who have preceded us have occasionally obtained some from the heaps. In the Danish heaps, they seem to have been quite common, and Mr. Rau found them so at Keyport.

Implements of *bone*, on the other hand, are quite abundant, as were also fragments of bone showing the marks of the instruments by which pieces had been detached, and of such there was a considerable variety. Some of the bones were cut across by making a groove around the circumference, as one would cut a notch in a stick, and breaking the rest; and others, as the metatarsal bones of the elk and deer, were split lengthwise, by making a groove on each side nearly to the marrow cavity, and completing the division by fracture. The roughly striated surface of the groove, and its undulating course indicate a piece of stone, and not a saw, as the instrument with which the work was done. We have found by experiment that this mode of working bone does not prove so great a labor

as it might at first sight seem to be, and with care have succeeded in splitting in two, lengthwise, in the course of an hour, a piece of human ulna seven inches long, by means of a flint "chip" held in the hand. This, of course, involves a large expenditure of time, but it must be remembered that an Indian's time was not valued. The work is rendered very much easier by keeping both the instrument and bone wet. It has been objected to the opinion, that certain implements from the European heaps were used as saws, that having wedge-shaped edges they would soon become "choked" or "jammed." Practically this does not happen, for we have uniformly found that the roughness of the sides of the flint is sufficient to widen the groove as fast as the edge deepens it.

Implements of bone made by the Indians dwelling in New England have rarely been mentioned, and are seldom seen in collections, but if one may judge from the number of specimens we have obtained, must have been in quite common use. The inhabitants of the North-west Coast, and the Esquimaux, are largely dependent upon this material, and Messrs. Squier and Davis found a few bone instruments in the mounds of Ohio. The accompanying figures, drawn by Mr. Morse, represent the forms of the more important ones discovered in the different heaps, which form the subject of this paper. Except the first, which is reduced one-half, linear measurement, all are represented of the natural size. We are unable to assign any uses for the larger part of them, and of the others can only offer a conjecture.

EXPLANATIONS OF PLATES 14 AND 15.

Fig. 1. This instrument is ten inches long, two inches and a half broad at the top, and one at the point. It is made of one of the branches of the antler of the moose or elk. The breadth of the upper

Fig. 1.

Fig. 4.

Fig. 5.

Fig. 3.

Fig. 2.

Fig. 2 *a*.

Fig. 18.

Fig. 19.

WYMAN ON THE SHELL-HEAPS OF NEW ENGLAND.

Fig. 9.

Fig. 10.

Fig. 8.

Fig. 11.

Fig. 14.

Fig. 16.

Fig. 7.

Fig. 13.

Fig. 15.

Fig. 12.

Fig. 17. 17*a*.

Fig. 6.

WYMAN ON THE SHELL-HEAPS OF NEW ENGLAND.

portion is not seen in the figure, as the piece is represented as seen edgewise. It is obliquely truncated at the lower end, so as to give it a chisel-shaped edge, and shows the effect of having been hacked by some dull tool. Attached to a handle it might be used to dig with, or might serve for the purpose of a head-breaker, or "casse-téte," as described by Father Rasles.* From Frenchman's Bay.

Fig. 2. A flat-pointed instrument, 3¾ inches long, and 1¼ wide. This is made of the dense exterior portion of an antler, and at the lower end has a thin sharp edge as in Fig. 2 *a*. From Crouch's Cove.

Fig. 3. A piece of one of the branches of the antler of a deer, from which the tip has been cut off. The sides near the pointed end have been worked down so as to present four faces, two of the angles uniting them being quite acute. The detached piece having a deep notch would be provided with two points or barbs, and would be adapted to serve as the point of an arrow. Such points were used by the aborigines, and we are informed by Winslow, that when the Pilgrims were making their first explorations on the shore at Cape Cod, previously to landing at Plymouth, some of the arrows shot at them had the kind of point just described.† From Cotuit Port.

Fig. 4. An artificially pointed fragment. From Crouch's Cove.

Fig. 5. An artificially pointed fragment of bone, suitable for the purpose of an awl. From Crouch's Cove.

Fig. 6. A fragment of a bone of a bird, obliquely truncated and artificially sharpened. From Crouch's Cove.

Fig. 7. One of the lower incisors of a beaver, ground to a thin, sharp edge, which last is formed by the enamel on the inner, or flat side of the tooth. From Crouch's Cove.

Fig. 8. A well wrought and polished spindle-shaped instrument, the lower end of which is flattened, and has a sharp edge; the upper portion is rounded with the end broken off, but appears to have been worked to a sharp point. From Frenchman's Bay.

Fig. 9. A slender piece of bone, smoothly wrought and pointed. From Frenchman's Bay.

Figs. 10 and 12, from Frenchman's Bay, and 11 and 13, from Crouch's Cove, are all made of flattened pieces, each being cut from the walls of one of the long bones, and showing the cancellated structure on one of the sides.

Fig. 15. From Eagle Hill; the serrated edge is quite sharp, but from this the bone rapidly increases to one-third of an inch in thickness, so as to render it wholly unsuitable to be used as a saw.

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* Lettres Edifiantes et Curieuse. Paris, 1838. Vol. I. p. 670.
† Young's Chronicles of the Pilgrims. Boston, 1841. p. 158.

Figs. 16 and 17 are flat, scraped very thin, as seen in 17*a*; one of them is made from the bone of a bird. From Eagle Hill.

The specimens represented by the figures just enumerated, together with other wrought pieces more or less mutilated, and collections of the bones and shells from each of the heaps, are preserved in the Peabody Museum of Archæology and Ethnology at Cambridge, and in the Ethnological Department of the Essex Institute in Salem. Of these specimens, those represented in Figs. 6, 7, 11, 13 and 14, were from the Rev. J. A. Swan; Figs. 1, 9, 12 from Mr. William A. Hayes; Figs. 2 and 4 from Mr. Horace Mann; Figs. 10 and 17 from Mr. F. W. Putnam; Fig. 15 from Mr. E. S. Morse, and Figs. 3, 5, 8, 10, from the writer.

THE CHICKADEE.

BY AUGUSTUS FOWLER.

THE Chickadee (*Parus atricapillus*) is a common resident, familiar alike in the woods and the dwellings of man. He fears not the storms of winter nor the heats of summer. Cautious yet bold, cunning though seemingly simple, he averts all suspicion of the whereabouts of his nesting-place, and, when discovered, scolds the intruder. Ever on the alert, the hawk cannot make him his prey, nor the smooth gliding snake surprise him in his nest. In times of incubation when danger approaches, the male,

before unseen, sallies forth and instantly appears before the intruder, hopping from branch to branch, keeping but a short distance from him, and remaining silent until he fears their retreat may be discovered, then he sounds the alarm. At the noise the female peeps out of her abode, and quickly dodges back to wait the issue. If their nesting-place is not seen, or the male has artfully drawn the person away, the pleasing notes, *Phe-be*, *Phe-be* are heard; but if the nest is disturbed, and the female routed, they are clamorous in reiterating the notes, *Pe-dee-dee-dee*. If their nest is destroyed, they linger about a day or two, then go in quest of another suitable place to build again, such as a rotten stump or decayed upright limb of a tree or post, which is easily perforated, and dig a hole in it to the depth of six to nine inches, with a diameter usually of two and a quarter inches.

They are often many days in preparing their tenement. Their labors are commenced in the morning of each day, both male and female working, and they work until about the middle of the forenoon, when they stop, and are seldom seen about the premises until the next morning. It seems as though the task before them would depress their spirits and discourage them in their undertaking, but energy and perseverance will accomplish much: bit by bit of rotten wood is taken out of the hole and carried by each bird ten or fifteen feet from the tree and dropped on the ground. There is no delay in their work except what arises from the difficulty of detaching the particles of wood from the sides or bottom of the cavity; for each bird, after dropping its light load, flies back to near the entrance and waits for the other to appear, when it enters the branch instantly. When the hollow is finished the bottom is concave, as usual in birds' nests.

There is usually in the vicinity of the nest a hollow tree, or cavity made on purpose for the male to roost in during the time of breeding; such retreats are also occupied by them in severe stormy weather in winter, in which they sometimes remain three or four days in succession. They make their nests of different materials; sometimes it is entirely of cow's hair, at others entirely of wool; usually it is composed of various materials, such as those named, together with fine grass, the fine dried roots of the willow, etc., and lined with some soft material. Its inside diameter is one and three-fourths inches; its depth one and one-fourth inches. The eggs, which are commonly eight in number, measure in length nine-sixteenths of an inch, and in breadth eight-sixteenths of an inch. They are marked with reddish-brown specks over the entire egg, more thickly at the larger end; sometimes, however, the spots are thicker on the smaller end of some of the eggs of the same brood. They raise two broods in a season. The Chickadee, when compelled from necessity to take up his abode in a cavity not made by himself, selects one with an entrance not much larger than his body, so that he is not so liable to become the prey of the Mottled-owl, as are the Golden-winged Woodpeckers, and Blue-birds. There are no species of birds that suffer so much from the depredations of the owl as the Golden-winged Woodpeckers. The deadliest foe to the Chickadee is the Great American Shrike, or Butcher-bird. Seated upon some prominent object the Shrike watches the movement of the little troop as they are busily engaged seeking their food in a variety of positions, unconscious of the sure death that awaits one of their number. While listening to the squeaking notes of the Brown Creeper which usually attends them, or

the shrill clarion voice of the Downy Woodpecker, you hear a noise like a falling stone through the branches of the tree; it is the shrike: he has struck his victim, and if he does not devour it upon the spot, it is hung on the crotch of a limb to serve as a meal at some future time.

DESMIDS AND DIATOMS.

No. II.

THEIR GROWTH AND GEOLOGICAL IMPORTANCE.

BY PROF. L. W. BAILEY.

[Concluded from page 517.]

In descending from the study of the higher to that of the lower forms of life, nothing is more remarkable than the manifold and often varied means by which that life is multiplied and perpetuated. In all four departments of the Animal Kingdom this is found to be the case, the higher groups in each producing for the most part a limited number of offspring, which, however, they nurse with proportionate care, while, as we pass to those occupying a lower grade, Nature seems to guard against the extinction of a species by vastly augmenting the reproductive power of the individual. So strikingly is this the case, that fishes, worms, the moss-like mollusca and the polyps, the lower groups under their several types, have been well styled the Embryonic or Reproductive Classes. Nor is this observation true only within the limits of a single department. It is equally the case when one of these classes is compared with another, the difference, however, now appearing not so much in an inequality in the number of actual offspring, as in the introduction of new modes of

multiplication, other than the development from eggs. It is true that the numbers of possible young contained in the roe of certain fishes far exceeds anything to be found in the case of either of the classes just alluded to, but of these comparatively few reach maturity; while, slightly among the worms, still more among the flower-like mollusca, and in a most remarkable degree among the coral-polyps, a new mode of reproduction is introduced, by which not mere immature undeveloped individuals only are brought forth, but individuals fully formed, perfect in all their organs, ready to assist at once in the labors of the community of which they form a part.

Hence it is, perhaps, that the lower forms of life have been and are of incomparably more importance than the higher, in modifying the earth's physical features, and in contributing material for its growth. The coral-polyp is a pigmy indeed beside the Mastodon, but while a fragmentary skeleton of the latter is here and there unearthed, the solid framework of the latter has, to a considerable extent, become also the framework of the globe, a portion of the masonry by which, tier upon tier, our continent has risen through successive ages.

In passing from the Animal to the Vegetable Kingdom, the fact to which we have made allusion is equally apparent. Reproduction by *seed*, though the normal, is by no means the only nor indeed the usual method of propagation. Were this the case, and were every form of vegetation but a single individual, how infinitely reduced would be that individual's chances of successfully resisting the thousand accidents to which it is subjected, how infinitely less varied and less beautiful would be the development of vegetable life. But every botanist knows, and every gardener practically proves, that a shrub or tree

is not a single indivisible being, but a *community* of individuals, each of them a potential plant, living, it is true, in intimate connection with others of its kind, but equally capable of living alone, when, with proper care, its connection with these latter is severed. Every plant, as it buds in spring, is but reproducing hundreds or perhaps thousands of new individuals, similar in every respect to that which originally sprung directly from the seed. Unlike what is seen in the Animal Kingdom, the higher as well as the lower orders share equally in this peculiar mode of growth; with this difference, however, that while among the higher groups the newly formed parts retain their connections, and become a portion of a compound structure, in the humbler groups they often separate as soon as formed, and acquire a distinct and independent existence.

Let us now observe some of the results of this process, as illustrated in the minute forms of vegetation to which this paper is more especially devoted.

In the last number of the NATURALIST it was shown, that, among the Desmids and Diatoms, though "conjugation" and the formation of seed-like bodies or spores is a normal mode of reproduction, yet here, as among higher plants, multiplication by this method is comparatively unimportant, by far the greater number of individuals arising from the self-division or fission of a single cell. So true is this, indeed, that the former mode, although probably true of all, has as yet been observed in but very few, and those the least remarkable species, while the process of budding or self-division is universal. Indeed, it is scarcely possible to examine a recent gathering of Diatoms, in which individuals will not be found illustrating all the different stages of development, from those in

which the "connecting membrane" has merely become slightly enlarged, to those in which it may be seen to contain two new individuals; these latter ready, by the disruption of the membrane, to acquire a separate existence, or, as is more commonly the case, to still maintain some slight connection with the parent cell, thus forming new members in a compound community.

The rapidity of this budding process is something astounding, and goes far to explain the geological importance of these organisms. Ehrenberg, the great microscopic observer, in alluding to this subject, observes that "the silicious infusoria (Diatoms) form, in stagnant waters during hot weather, a porous layer of the thickness of the hand. Although more than 100,000,000 weigh hardly a grain, one may, in the course of half an hour, collect a pound's weight of them; hence it will no longer seem impossible that they may build up rocks;" and Professor Smith, the author of a standard work on these organisms, has calculated, as the progeny of a single diatomaceous cell, the amazing number of one thousand millions in a single month. These facts are certainly calculated to awaken our astonishment, yet wonderful as they are as illustrations of the reproductive power, they are but a repetition of what actually occurs throughout the whole vegetable kingdom. Take for example the century plant of our conservatories. An excellent authority tells us that, shooting forth its flower-stalk at the rate of a foot in twenty-four hours, it actually produces no less than twenty thousand millions of cells in a single *day;* and many other plants, in a greater or less degree, illustrate the same fact. In both cases the new cells are microscopic, but while in the higher forms they remain aggregated to produce a close and compact structure, of a more

or less limited duration, among the Diatoms the new cells become new individuals; and though, as *living* forms, their duration is brief, yet incorporating as they do into their tissues the almost indestructible element, silica, to a greater extent than in any other group of organisms, they become as it were *petrified*, even while still alive, and at death leave behind relics, minute indeed, but imperishable, the most perfect of fossils, in which every groove and marking of their former selves is accurately and beautifully preserved.

We have, then, only to reflect for a moment upon the almost universal distribution of the Diatomaceæ, to understand how, by rapid growth and the formation of indestructible remains, they may readily become of great importance in a physical and geological point of view. They are found alike in fresh, salt, and brackish water; in moist earth and in tidal muds; in hot springs and in river ice, from the poles to the equator, coloring vast tracts of the surface of the sea, as well as composing the great bulk of the ocean's bed. Even in the lava and cinders of volcanoes their presence has been recognized, and they form a large portion of the dust-showers and "blood-rains" formerly so dreaded, and which cover at times with powder the sails of ships at sea. Mr. Roper, an English microscopist, tells us, that, excluding coarse sand, one-fourth of the finer part of the residuum of the mud of the Thames is composed of the silicious remains of the Diatomaceæ, and expresses his belief that their silicious shells "have a perceptible influence in the formation of shoals and mud-banks." Dr. Hooker, again, in speaking of the results obtained by the Antarctic Expedition, observes that they abound in the newly-formed ice of the Polar Seas, producing by their death a submarine deposit of vast

dimensions, occupying probably an area of 400 miles long by 120 wide, resting in part upon a glacier 400 miles in length, and in part upon the submarine flanks of Mount Erebus, an active volcano 12,000 feet in height! Finally, Ehrenberg considers that at Pillau, in Germany, "there are annually deposited from the water from 7,200 to 14,000 cubic metres of fine microscopic organisms, which, in the course of a century, would give a deposit of from 720,000 to 1,400,000 cubic metres of Infusory-rock or Tripoli-stone."

So much for the rapidity of growth and the physical importance of the Diatoms in our own era; let us now glance for a moment at earlier periods, and see whether these minute organisms were then too at work, producing results at all comparable to those which we witness at the present day.

To begin with the more recent geological epochs. Every tyro in microscopic inquiry has, among his other curiosities, obtained at least one slide with the label "Fossil Infusoria." These are Diatomaceæ, and the deposits from which they are derived may be found in all parts of our country, cropping out on the borders of ponds, or underlying layers of peat. It is, however, often a matter of doubt, especially in the former case, where the forms of the deposit and those still living in the water are apparently identical, how far these may really be entitled to the designation of "fossils." That they are so in many cases, and almost always when underlying beds of peat, is shown by the entire absence in these latter of certain species (especially *Nitschia* and *Synedra*), while these species are *growing* in the waters of the same locality in the greatest profusion. The period of the introduction of these species, then, must constitute

one epoch in the geological history of the Diatoms, and more attentive study will yet reveal the occurrence of similar special epochs in the case of other species, even though we may not be able to directly synchronize these epochs with those determined from other data.* But leaving the region of uncertainty, there are numerous deposits, the great antiquity of which is placed beyond a doubt. Among these we may first enumerate a deposit in which were found imbedded, in 1843, the bones of a Mastodon, in Orange county, N. Y., and which, from its peculiar connection with these bones, was undoubtedly of contemporaneous origin. Being unaffected by severity of climate, it is probable that the Diatoms continued to exist through the whole Post-tertiary Period, affording, by the entire absence of marine species, another confirmation of the much-disputed Glacier theory of Professor Agassiz. Again receding, the next deposits of which the age may be considered as definitely fixed, are those of Virginia and Maryland, the most celebrated of all diatomaceous earths, from the extreme variety and beauty of their forms and the extent of the beds containing them. These beds, where they underlie the city of Richmond, are not less than twenty feet in thickness, and consist entirely of marine remains; while deposits, similar in character, and probably contemporaneous in origin, are found at many localities as far as Piscataway, in the State of Maryland. They are referred by their discoverer, Professor W. B. Rogers, to the Miocene Tertiary. One cubic inch of the earth has been calculated to contain not less than several millions of individual shells. Many similar deposits have been observed both in America and

*For an interesting article on this subject, see a paper entitled "Some new and intermediate Forms of Diatomaceæ," by Dr. F. W. Lewis, in the Proceedings of the Philadelphia Academy of Natural Sciences, December, 1863.

Europe, but little has as yet been done in determining their precise age, or in accounting for the conditions necessary for the local accumulation of such vast quantities of material. Among the most remarkable in this respect are those of our western coast. I have now before me a block of pure diatomaceous earth, a foot and a half long by half a foot in depth, of chalk-like whiteness, sent by Mr. W. P. Blake, from Monterey (the entire weight of which is only about six pounds), and other similar beds are found at many points in Mexico, California, and Oregon. One of these, discovered by Colonel Frémont on the Columbia River, surpasses all other known deposits, being not less than 500 feet in thickness, and covered by at least 100 feet of compact basalt and other volcanic products!

It is probable that the Mexican and California beds, like those of Richmond, are of Tertiary age, though some of them may prove to be Cretaceous. That those of Monterey and San Francisco are far more ancient than the present physical features of California is proved by their being purely marine deposits, and by their differing wholly in character and species from other deposits, also of considerable thickness, from the eastern side of the Sierras, which I have lately had an opportunity of examining. These latter are fluviatile or lacustrine, and contain many species identical with those of the ordinary subpeat deposits of the Eastern States.

In passing from the Tertiary to earlier formations, the evidence of the existence of the microscopic Algæ becomes less evident, and for a long time none were believed to exist of more ancient date than those above alluded to. Certain peculiar organisms termed Xanthidia were, however, observed as of frequent occurrence in

the flint-nodules of the chalk formation, and within a still more recent period similar forms have been observed in the analogous hornstones of the Devonian and Silurian ages, associated in this latter case with unequivocal Diatomaceous shells. As regards these Xanthidia, which have usually been regarded as remains of Desmids, it is certainly singular that, while all recent Desmids are purely fresh water, these should occur in marine deposits; and secondly, that, destitute as they are for the most part of the silicious shell of the Diatoms, they should occur in a fossil state at all. Yet the resemblance is certainly a striking one, and their occurrence with the kindred Diatomaceæ throws some degree of plausibility upon this belief. However this may be, the existence of one group at least of these organisms being established for these early periods, we can scarcely doubt that their numbers were as great then as in the seas of our own day, and that they have been present through all the great geological ages, even though metamorphism and other agencies have for the most part obliterated all traces of their beautiful but fragile shells. It is highly probable that accompanying the lower forms of animal life, these humble types of vegetation were among the first introduced upon the globe, performing then, as their representatives now do in the arctic seas and at great depths, where the higher forms of vegetation are wanting, the part of purifying the waters, as well as of contributing food for the sustenance of the different forms of animal life with which they were associated.

Thus we see that the lower no less than the higher forms of life have their appointed place, each fulfilling its own part, and each worthy of the admiration and the study of the observing mind.

THE HOME OF THE BEES.

BY A. S. PACKARD, JR., M. D.

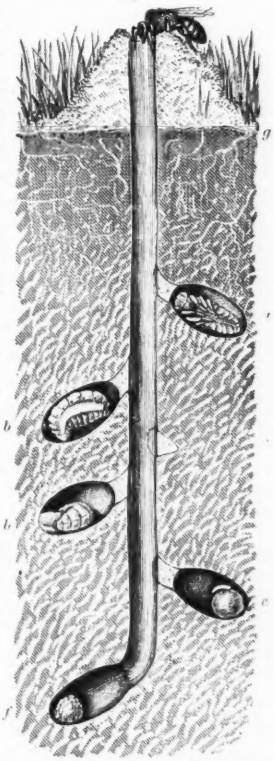
(Concluded from page 378.)

WHILE the Andrena and Halictus bees, whose habits we now describe, are closely allied in form to the Hive-bee, socially they are the "mud-sills" of bee society, ranking among the lowest forms of the family of bees, or *Apidæ*. Their burrowing habits ally them with the ants, from whose nests their own burrows can scarcely be distinguished. Their economy does not seem to demand the exercise of so much of a true reasoning power and pliable instinct as characterizes those bees, such as the Honey and Humble-bee, which possess a high architectural skill. Moreover they are not social; they have no part in rearing and caring for their young, a fact that lends so much interest to the history of the Hive and Humble-bee. In this respect they are far below the wasps, or *Vespidæ*, a family belonging next below in the system of Nature.

A glance at Mr. Emerton's admirable drawing (Fig. 1) of a burrow of *Andrena vicina* Smith, reveals the economy of one of our most common forms. Quite early in spring, when the sun and vernal breezes have dried up the soil, and the fields exchange their rusty hues for the rich green verdure of May, our Andrena, tired of its idle life among the blossoms of the willow, the wild cherry, and garden flowers, suddenly becomes remarkably industrious, and wields its spade-like jaws and busy feet with a strange and unwonted energy. Choosing some sunny, warm, grassy bank (these nests were observed in the "great pasture" of Salem), not always with a southern exposure however, the female sinks her deep well through

the sod from six inches to a foot into the sandy soil beneath. She goes to work literally tooth and nail. Reasoning from observations made on several species of wasps, and also from studying the structure of her jaws and legs, it is evident that she digs in and loosens the soil with her powerful jaws, and then throws out the dirt with her legs. She uses her forelegs like hands, to pass the load of dirt to her hind legs, and then runs backward out of her hole to dump it down behind her. Mr. Emerton tells me that he never saw a bee in the act of digging but once, and then she left off after a few strokes. He also says, "they are harmless and inoffensive. On several occasions I have laid on the grass near their holes for hours, but not one attempted to sting me; and when taken between the fingers, they make but feeble resistance."

Fig. 1.



Nest (natural size) of *Andrena vicina*, showing the main burrow, and the cells leading from it; the oldest cell containing the pupa (*a*) is situated nearest the surface, while those containing the larva (*b*) lie between the pupa and the cell (*e*) containing the pollen mass and egg resting upon it. The most recent cell (*f*) is the deepest down, and contains a freshly deposited pollen mass. At c is the beginning of a cell; *g*, level of the ground.

To enter somewhat into detail, we gather from the observations of Mr. Emerton (who has carefully watched the habits of these bees through several seasons) the following account of the economy of *An-*

drena vicina. On the 4th of May the bees were seen digging their holes, most of which were already two inches deep, and one six inches. The mounds of earth were so small as to be hardly noticed. At this time an Oil-beetle (*Meloë*) was seen prowling about the holes. The presence of this dire foe of Andrena at this time, it will be seen in a succeeding paper on the enemies of the bees, is quite significant. By the fifteenth of May hundreds of Andrena holes were found in various parts of the pasture, and at one place, in a previous season, there were about two hundred found placed within a small area. One cell was dug up, but it contained no pollen. Four days later, several Andrenas were noticed resting from their toil at the opening of their burrows. On the twenty-eighth of May, in unearthing six holes, eight cells were found to contain pollen, and in two of them a small larva. The pellets of pollen are about the size of a pea. They are hard and round at first, before the young has hatched, but as the larva grows the mass becomes softer and more pasty, so that the larva buries its head in the mass, and greedily sucks it in. When is the pollen gathered by the bee and kneeded into the pellet-like mass? On June 4th, a cell was opened in which was a bee busily engaged preparing the pollen, which was loosely and irregularly piled up, while there was a larva in an adjoining cell nearly half an inch long. It would seem, then, that the bee comes in from the fields laden with her stores of pollen, which she elaborates into bee-bread within her cell.

When the bee returns to her cell she does not directly fly towards the entrance, since, as was noticed in a particular instance, she flew about for a long time in all directions without any apparent aim, until she finally settled near the hole, and walked into her subterranean

retreat. On a rainy day, May 24th, our friend visited the colony, but found no bees flying about the holes. The little hillocks had been beaten down by the pitiless rain-drops, and all traces of their industry effaced. On digging down, several bees were found, indicating that on rainy days they seek the shelter of their holes, and do not take refuge under leaves of the plants they frequent.

On the 29th of June six full-grown larvæ were exhumed, and one about half grown. On the 20th of July the colony seemed well organized, as, on laying open a burrow at the depth of six inches, he began to find cells. The upper ones, to the number of a dozen, were deserted and filled with earth and grass roots, and had evidently been built and used during the previous year. Below these were eight cells placed around the main vertical gallery, reaching down to the depth of thirteen inches, and all containing nearly full-grown larvæ of the bees, or else those of some parasitic bee (*Nomada*) which had devoured the food prepared for the young Andrena.

About the first of August the larva transforms to a pupa or chrysalis; as at this time two pupæ were found in cells a foot beneath the surface. As shown in the cut, those cells situated lowest down seem to be the last to have been made, while the eggs laid in the highest are the first to hatch, and the larvæ disclosed from them the first to change to pupæ. Four days later the pupæ of *Nomada*, or Cuckoo-bees, were found in the cells. No Andrenas were seen flying about at this time.

On the 24th of August, to be still very circumstantial in our narrative, though at the risk of being tedious, three burrows were unearthed, and in them three fully formed bees were found, nearly ready to leave their cells, and in addition several pupæ. In some other cells

there were three of the parasitic Nomada also nearly ready to come out, which seemed to be identical with some bees noticed playing very innocently about the holes early in the summer.

On the last day of August, very few of the holes were open. A number of Oil-beetles (*Meloë*) were strolling suspiciously about in the neighborhood, and some little black Ichneumon flies were seen running about among the holes.

During midsummer the holes were found closed night and day by clods of earth.

The burrow is sunken perpendicularly, with short passages leading to the cells, which are slightly inclined downwards and outwards from the main gallery. The walls of the gallery are rough, but the cells are lined with a mucous-like secretion, which, on hardening, looks like the glazing of earthen-ware. This glazing is quite hard, and breaks up into angular pieces. It is evidently the work of the bee herself, and is not secreted and laid on by the larva. The diameter of the interior of the cell is about one-quarter of an inch, contracting a little at the mouth. When the cell is taken out, the dirt adheres for a line in thickness, so that it is of the size and form of an acorn.

The larva of Andrena (Fig. 2) is soft and fleshy, like that of the Honey-bee. Its body is flattened, bulging out prominently at the sides, and tapering more rapidly than usual towards each end of the body. Seen sideways, the thoracic rings are quite prominent, giving a serrated outline to the body. The skin is very thin, so that along the back the heart or dorsal vessel may be distinctly seen, pulsating about sixty times a minute.

Our cut (Fig. 1) also represents the pupa, or chrys-

alis, as seen lying in its cell. The limbs are folded close to the body in the most compact way possible. On the head of the semi-pupa, *i. e.* a transition state between the larva and pupa, there are two prominent tubercles situated behind the simple eyes, or ocelli; these are deciduous organs, apparently aiding the insect in moving about its cell. They disappear in the mature pupa.

Fig. 2.

Fig. 3.

Fig. 4.

To those accustomed to rearing butterflies, and seeing the chrysalis at once assuming its perfected shape, after the caterpillar skin is thrown off, it may seem strange to hear one speak of a "half-pupa," and of stages intermediate between the larva and pupa. But as we have before stated on page 429, the external changes of form, though rapidly passed through, consisting apparently of a mere sloughing off of the outer skin, are yet preceded by slow and very gradual alterations of tissues, resulting from the growth of cells.* An inner layer of the larva-skin separates from the outer, and, by changes in the form of the muscles, is drawn into different positions, such as is assumed by the pupa, which thus lies concealed beneath the larva-skin. But a slight alteration is made in the general form of the larva, consisting mostly of an enlargement of the thoracic segments, which is often overlooked, even by the special student, though of great

Fig. 2. Larva of *Andrena vicina* Smith.
Fig. 3. Pupa of *Halictus parallelus* Say seen from beneath.
Fig. 4. Larva of *H. parallelus.*

*On page 429, line 5, we say, "the changes though rapid are gradual." It should read, the changes (*i. e.* actual moultings) are rapid, though the steps that lead to them are gradual.

interest to the philosophic naturalist. Special attention has been drawn to this "semi-pupa" state by Ratzburg, in his "Development of Footless Hymenopterous Larvæ," and by Professor Agassiz, in his "Classification of Insects from Embryological Data" (Smithsonian Contributions), wherein he refers to the changes of the caterpillar of a butterfly (*Eudamus Tityrus*), just before assuming the chrysalis or pupa state.

From Mr. Emerton's observations we should judge, that the pupa state lasted from three to four weeks, as the larvæ began to transform the first of August, and appeared during the last week of the same month as perfect bees.

Andrena vicina is seen as late as the first week in September, and again early in April, about the flowers of the willow. It is one of the largest of its genus and a common species.

Having, in a very fragmentary way, sketched the life-history of our Andrena, and had some glimpses of its subterranean life, let us now compare with it another genus of solitary bees (*Halictus*) quite closely allied in all respects, though a little lower in the scale.

The *Halictus parallelus* Say, excavates cells almost exactly like those of Andrena; but since the bee is smaller, the holes are smaller, though as deep. Mr. Emerton found one nest in a path a foot in depth. Another nest, discovered September 9th, was about six inches deep. The cells are in form like those of Andrena, and like them are glazed within. The egg is rather slenderer and much curved; in form it is long, cylindrical, obtuse at one end, and much smaller at the other. The larva (Fig. 4) is longer and slenderer, being quite different from the rather broad and flattened larva of Andrena. The body is

rather thick behind, but in front tapers slowly towards the head, which is of moderate size. Its body is somewhat tuberculated, the tubercle aiding the grub in moving about its cell. Its length is nearly one-half (.40) of an inch. On the pupa are four quite distinct conical tubercles forming a transverse line just in front of the ocelli; and there are also two larger, longer tubercles on the outer side of each of which an ocellus is situated. Figure 3 represents the pupa seen from beneath.

Search was made on July 16th, when the ground was hard as stone for six inches in depth, below which the soil was soft and fine, and over twenty cells were dug out. "The upper cells contained nearly mature pupæ, and the lower ones larvæ of various sizes, the smallest being hardly distinguishable by the naked eye. Each of these small larvæ was in a cell by itself, and situated upon a lump of pollen, which was the size and shape of a pea, and was found to lessen in size as the larva grew larger. These young were probably the offspring of several females, as four mature bees were found in the hole." The larva of an English species hatches in ten days after the eggs are laid.

Another brood of bees appeared the middle of September, as on the ninth of that month (1864) Mr. Emerton found several holes of the same species of bee made in a hard gravel road near the turnpike. When opened, they were found to contain several bees with their young. September 2d, of this year, the same kind of bee was found in holes, and just ready to leave the cell. It is probable that these bees winter over.

We have incidentally noticed the presence in the nests of Andrena and Halictus of a stranger bee, clad in gay, fantastic hues, which lives a parasitic life on its hosts.

This parasitism does not go far enough to cause the death of the host, since we find the young of the parasitic *Nomada*, or Cuckoo-bee, in cells containing its young.

Mr. F. Smith, in his "Catalogue of British Bees," says of this genus: "No one appears to know anything beyond the mere fact of their entering the burrows of *Andrenidæ* and *Apidæ*, except that they are found in the cells of the working bees in their perfect condition: it is most probable that they deposit their eggs on the provision laid up by the working bee, that they close up the cell, and that the working bee, finding an egg deposited, commences a fresh cell for her own progeny."

He has, however, found two specimens of *Nomada sexfasciata* in the cells of *Eucera longicornis*, the Long-horned bee. He also states, that while some species are constant in their attacks on certain Halicti and Andrenæ, others attack different species of these genera indiscriminately. In like manner another Cuckoo-bee (*Cœlioxys*) is parasitic on *Megachile* and *Saropoda; Stelis* is a parasite on *Osmia*, the Mason-bee; and *Melecta* infests the cells of *Anthophora*.

The observations of Mr. Emerton enable us still farther to clear up the history of this obscure visitor. He found both the larva and pupa, as well as the perfect bee, in the cells of both genera; so that either both kinds of bee, when hatched from eggs laid in the same cell, feed on the same pollen mass, which therefore barely suffices for the nourishment of both; or the hostess, discovering the strange egg laid, cuckoo-like, in her own nest, has the forethought to deposit another ball of pollen to secure the safety of her young.

Is such an act the operation of a blind instinct? Does it not rather ally our little bee with those higher animals

which undoubtedly possess a reasoning power? Its *instinct* teaches it to build cells, and prepare its pollen mass, and lay an egg thereon. Its *reason* enables it, in such an instance as this, when the life of the brood is threatened, to guard against any such danger by means to which it does not habitually resort. This instance is paralleled by the case of our common Summer Yellow-bird, which, on finding an egg of the Cow-bunting in its nest, often builds a new nest above it, to the certain destruction of the unwelcome egg in the nest beneath.

In the structure of the bee, and in all its stages of growth, our parasite seems lower in the zoölogical scale than its host. It is structurally a degraded form of Working-bee, and its position socially is unenviable. It is lazy, not having the provident habits of the Working-bees; it aids not in the least, so far as we know, the cross-fertilization of plants,—one great office in the economy of nature which most bees perform,—since it is not a pollen-gatherer, but on the contrary is seemingly a drag and hinderance to the course of nature. But yet nature kindly, and as if by a special interposition, for which the Developmentists will find it difficult to account, provides for its maintenance, and the humble naturalist can only exclaim, "God is great, and His ways mysterious," and go on his way studying and collecting facts, leaving to his successors the more difficult task, but greater joy of discovering the cause and reason of things that are but a puzzle to the philosophers of this day.

The larva of *Nomada* may be known from those of its host, by its slenderer body and smaller head, while the body is smoother and more cylindrical. Both sexes of *Nomada imbricata* and *N. pulchella* of Smith were found by Mr. Emerton, the former in both the Andrena and

Halictus nests, and both species were found in a single Andrena nest.

The interesting history of the Oil-beetle (*Meloë*) and its wonderful transformations, and of the Stylops and other bee-parasites, cannot now detain us. We hope to lay an account of them before our readers at some future time.

THE LAND SNAILS OF NEW ENGLAND.

BY EDWARD S. MORSE.

(Continued from page 547.)

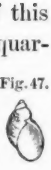
THE genus Succinea, of which we have three marked species in New England, is furnished with a thin, translucent, and elastic shell. The soft parts resemble those of Helix, but the creeping disk is quite short and broad, and the tentacles are short and swollen at their bases. The shell is entirely unlike Helix, being ovate-conic, and not rolled in a plane.

SUCCINEA TOTTENIANA. (Fig. 46.) Shell ovate, amber-colored, thin, translucent, shining. Whorls about three, the last very large; spire not prominent, suture distinct. The aperture is three-fourths the length of the shell, and so open that the animal when contracted within the shell is plainly visible. Length of shell from $\frac{5}{8}$ to $\frac{3}{4}$ of an inch. The animal is of a salmon-color, and the shell is sufficiently translucent to reveal the color of the viscera within. This species appears to be confined to New England and the Provinces. It is represented in the Western States by *S. obliqua*, a heavier and larger shell. It occurs in woods and fields. Sometimes found in great numbers in the roadways after a heavy dew.

Fig. 46.

SUCCINEA AVARA *Say*. (Fig. 47.) The shell of this species is smaller than the preceding, being only a quarter of an inch in length. The spire is quite long, and the aperture is only half the length of the shell. The whorls are three in number, very convex, separated by a deep suture. The color is greenish or grayish straw. The surface of the shell is usually covered with a coating of dirt, accumulated by the fine hairs that stud its surface. This character alone is sufficient to distinguish the species. Common in damp woods.

Fig. 47.



SUCCINEA OVALIS *Gould*. (Fig. 48.) Shell very thin, pellucid, pale horn-color, polished, elongate. Spire short; aperture expanding in front. Length less than half an inch. The shell is quite elastic, and so translucent that all the organs are plainly visible, and the pulsations of the heart are distinctly seen. The animal is amber-colored, mottled with black dots. Inhabiting the Northern and North-eastern States. This species appears to be confined to the margin of pools in wet grass, and is often found clinging to the leaves of aquatic plants in ponds.

Fig. 48.

The following species belong to a genus of which there are but two species, one belonging to this country, and the other to the old world. The two resemble each other very much, and are regarded as the same species by many.

Fig. 49.

ZUA LUBRICOIDES *Stimpson*. (Fig. 49.) Shell cylindrical, oblong, smooth, and brilliantly polished; transparent, smoky horn-color. Whorls five or six, rounded. Length $\frac{3}{10}$ of an inch; aperture oval; lip thickened; animal bluish-black. The shell is about the size of a grain of wheat. Its usual haunt

is beneath decaying leaves in forests, though it is found in grass, and under stones by the roadside. In some places the species occur in great numbers.

It is distributed throughout the Northern, Middle, and Western States.

The next species forms another genus under the name of *Zoögenetes*. It was first described as a Helix by Say.

ZOÖGENETES HARPA *Say*. (Figs. 50, 51.)* Shell ovate conic, light horn-color, very thin and elastic. Whorls four, convex, the last two marked by thin prominent ribs; suture distinct; aperture nearly circular; lip sharp. Length ⅛ of an inch, animal slate color, mottled with light dots.

Figs. 50, 51.

This species forms one of the few exceptions among land snails, in which the young are brought forth alive. They are hatched from eggs, but the eggs are retained within the parent when this process takes place. The adult never contains more than four or five at a time, and it is a curious sight to break open this tiny shell under the microscope, and find within several young ones, those more advanced with little shells already formed. It is found in various parts of Maine, and is quite common in the vicinity of Portland in hard-wood groves. L. L. Thaxter has found it at Ascutney, Vt. It was first discovered in the North-west Territory, and between these two regions has rarely been met with.

The next group of species to be described have long cylindrical shells, and are among the smallest of our land snails.

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* We are indebted to the Smithsonian Institution, Washington, D. C., for the use of Figs. 50, 51.

The first that we shall describe is PUPILLA BADIA *Adams*. (Fig. 52.) The shell is oblong, cylindrical, having six or seven rounded whorls; color light brown, faintly striated, aperture nearly circular; the lip is thickened. Length $\frac{1}{4}$ of an inch. Prof. Adams first described this species from Lake Champlain, and stated that the aperture contained a tooth on the body whorl. Specimens from Maine have no such character. Mr. C. B. Fuller first discovered this species in Maine. It is extremely common in certain places in the vicinity of Portland. Mr. W. C. Cleveland has found it on Oak Island, Chelsea, Mass. This species is also ovoviviparous, that is, it brings forth its young alive.

Fig. 52.

PUPILLA FALLAX *Say*. (Fig. 53.) Shell oblong, having six convex whorls, which taper from the base to the apex, forming a pointed spire; aperture rounded, bordered by a broad white lip; umbilicus minute; color light brown, distinctly striated. Length $\frac{1}{5}$ of an inch; animal black; upper tentacles long and slender. Occurring in the Northern, Middle, and Western States, also in South Carolina. This can hardly be considered a New England species, as but few places have been noted where it occurs. Adams speaks of its being found in Vermont, and Mr. Thaxter has found the dead specimens in Woburn, Mass.

Fig. 53.

Those who have collections of minute land shells, would do well to provide themselves with a good magnifying glass, with the help of which they would be able to make out the species from the figures given.

NOTE.—The smaller figures accompanying the larger ones, indicate the natural size of the shells.

REVIEWS.

OBSERVATIONS ON THE GLACIAL PHENOMENA OF LABRADOR AND MAINE, WITH A VIEW OF THE RECENT INVERTEBRATE FAUNA OF LABRADOR. By *A. S. Packard, Jr., M. D.* With two Lithographic Plates. (From the Memoirs of the Boston Society of Natural History, Vol. I. Part 2.) pp. 94, 4to. Boston, 1867.

The author gives a sketch of the topography and geology of the coast of Labrador, followed by a special account of the drift or glacial phenomena in Labrador and Maine, describing four epochs in the history of the post-tertiary, or quaternary period: —

1. The true glacial epoch, during which Labrador and New England stood five hundred or six hundred feet higher than at present, and huge glaciers extended down to the sea from the various water-sheds. New England and Labrador, in other words, presented along their seashores "a nearly solid front of glacial ice, at least rivalling in height and breadth the enormous glacier 1,000 feet thick, and 540 miles long, discovered by Sir James Ross, in the antarctic lands."

2. *The Leda Clay*, or our common brickyard clays, during which epoch the land slowly sank, and the glaciers retreated up the valleys of the various water-sheds, leaving behind them the thick deposit of clay, gravel, and boulders which now covers the surface of New England. "During the slow and gentle submergence of the land ushering in this epoch, the crude moraine matter (heaps of stone and gravel borne upon the surface of the glaciers) was sorted into beds of regularly stratified clays one hundred to three hundred feet in thickness." — "An arctic fauna and flora inhabited the coast between the sea and the low snow-line, and the flora and fauna which are now found only on our Alpine heights, or in cold, isolated spots on the coast of Maine and the Northern lakes, then peopled the surface of New England and Canada."

3. "Period of raised Beaches (*Saxicava Sands*), during which the land emerged to its present elevation, and the fauna and flora assumed their existing relations. The close of this period witnessed the surface of New England covered by broad lakes and ponds, with vast rivers and extensive estuaries, and deep fiords cutting up the coast-line. Its scenic features must have resembled those of Labrador at the present day."

4. The Terrace Epoch marks the period subsequent to the more general recession of the sea during the preceding period, when the estuaries and deep bays were contracting to their present size.

From the fossils found at various localities in Labrador, Canada, and

New England, it is inferred that the distribution of marine animals on the shores of North-eastern America "was governed by the same laws as at the present day. In going southward from Labrador to New York the seas became warmer the more they came in contact with the heated waters of the Gulf Stream, whose influence was evidently exerted on the coast of New England during the Glacial Period." The climate of New England was not purely arctic, like that of Greenland, but rather subarctic like that of Labrador, while now it is much warmer, being "boreal," or north temperate.

These studies on surface geology have attracted and always will attract much attention. Especially interesting is the occurrence of fossils in our clay and sand deposits, and we beg our readers to carefully preserve all shells and bones and other remains which may be found in making excavations for roads or wells. We are liable to discover in these deposits the bones of the mastodon, the elephant, the walrus, bison, and various species of whales. It is not improbable that the horse will be found to have lived in New England during the Terrace Period, immediately succeeding the disappearance of glaciers, and in fact every thing is to be determined regarding the distribution of life during these dark ages, either immediately preceding or accompanying the appearance of man on the earth.

The work closes with a catalogue of the marine animals dredged along the coast of Labrador, with descriptions of over twenty new species. The plates are beautifully executed, illustrating rare and interesting fossils from the Leda clays, and living forms of shells, worms, and crustaceans, with a geological map of that portion of the coast visited by the author. — A. H.

The Quarterly Journal of Science. London. October, 1867.

We run hastily through the October number. Mr. Alfred Wallace, in "Creation by Law," reviews the Duke of Argyll's "Reign of Law." A very attractive plate represents an imaginary species of Hawk-moth (Sphinx) fertilizing by moonlight the flowers of an orchid growing in the forests of Madagascar, whose long, slender nectary hangs down twelve inches. Wallace argues that "the splendor of the humming-birds, is directly connected with their very existence." The most gaily-colored males are preferred by the more homely females, "which would lead to the individuals so adorned having more than the average number of offspring," adding, that "Mr. Darwin has lately arrived at the wonderful generalization that flowers have become beautiful solely to attract insects to assist in their fertilization." He adds, "I have come to this conclusion from finding it an invariable rule, that when a flower is fertilized by the wind, it never has a gaily-

colored corolla."—Cuthbert Collingwood writes on the Luminosity of the Sea.—Our Field Clubs, their Aims, Objects, and Work, notices the existence of institutions which have but recently started into growth, and seem as popular in England, as the Essex Institute in its summer dress seems to be in our Essex county. There, as with us, such meetings result in a wide diffusion of a taste for Natural History, and the managers of such meetings should bear in mind that "the excursion programme should in every case be drawn up with due consideration for the predilections of incipient naturalists." The Liverpool Naturalists' Field Club has 720 members. Its president states, "Large numbers join our excursions who are not particularly interested in any branch of natural science, and this is just what the chief object of our club renders a desirable circumstance. Special trains are made up, and journeys often of 160 miles a day, at a cost, including a substantial dinner-tea, of about seven shillings each, allowing five hours for work at the localities visited," give rest, recreation, and instruction to hundreds. During the past few years, the Institute Field Meetings have been deservedly popular in Essex county, from five hundred to two thousand persons attending them, and have done much to popularize scientific, historical, and antiquarian research.

From the Chronicles of Science, we learn that "India seems likely to be able to supply the whole world with quinine; for not only was the American supply uncertain, it was actually threatened with extinction, owing to the reckless way in which the Indians killed the trees in the process of stripping, planting, of course, no new ones."—M. Naudin believes that "monstrous" plants may become new species. A Poppy "took on a remarkable variation in its fruit,—a crown of secondary capsules being added to the normal central capsule. A field of such poppies was grown, and M. Göppert, with seed from this field, obtained still this monstrous form, in great quantity. Deformities of ferns are sometimes sought after by fern-growers. They are now always obtained by taking spores from the abnormal parts of a monstrous fern, from which spores ferns, presenting the same peculiarities, invariably grow."—"The Earl of Selkirk throws great doubt on the received creed as to the secular rise of land in Scandinavia."—Dr. Landois and W. Thelen show that there is an apparatus for closing the tracheæ of insects, which apparatus is often so developed, as to serve as a vocal organ.

The interest in the "Glass Rope controversy," regarding the nature of this very curious and remarkably elegant sponge or polyp, supposed to have been an artificial Japanese product, has been heightened by the alleged discovery of a European *Hyalonema*, or "Glass

Rope," off the coast of Portugal.—Dr. Pigeaux "believes that never, or quite accidentally and rarely, does the hare breed with the rabbit. The so-called Léporides are true rabbits, and not hybrids at all. The belief in the existence of such a hybrid was prevalent among the ancients."

Additional evidence has been obtained from the exploration of Kent's Cavern, Devonshire, that man was a contemporary with the mammoth, in the British Isles.—Messrs. Wistaw and Burk state that "falcons and hawks act as nature's police, and check the spread of disease and epidemics amongst birds, by killing off the weakly individuals of a covey."

Dr. Anton Dohrn, believes that all crustacea, insects, and arachnida, can be traced to a single parent form, which they each reproduce at one or the other period of development. This form is identical with the larva of Cirrhipedes (Barnacles); and he gives it the name of *Archizoëa*. But do insects pass through the form of a young barnacle? Without committing ourselves to Darwinian views, should we not rather look upon the *worm* as being the archetypal form of articulates, as they all assume this state in the course of development? Dohrn's *Archizoëa*, or articulate prototype, with better reason, we would suggest, takes on a worm-like form.—Mr. Wallace has published a most interesting paper "On the Relation between Sexual Differences of Color and Nidification in Birds."—"He runs over in detail the principal species of birds, having the female as beautiful and brilliant, or as conspicuous as the male. In cases where the female has this conspicuous appearance, the nest always conceals the female, and in cases where the female is of a dull color, the nest exposes a considerable portion of the sitting bird. When the male bird is less brilliant than the female, it is found that the male performs the duties of incubation. There thus seems to be a connection between the color of the different sexes of birds and the sitting over the eggs. There are some exceptions to this generalization, but they can be easily explained, for these are generally protective colors. Mr. Wallace considered that Darwin's principle of natural selection most aptly explained this connection of color and nests."

THE NATURALIST'S NOTE BOOK. London. January—October, 1867.

This journal culls from all departments of Natural History, forming a common-place-book of selections, and is a very entertaining monthly. Our contributors will be pleased to know that a dozen or more of articles from the AMERICAN NATURALIST appear in its pages with due credit.

Bee keepers will examine with interest Mr. J. Lowe's "Observa-

tions on Dzierzon's Theory of Reproduction in the Honey-bee," read to the London Entomological Society.

With a view to test the truth of the theory that "all eggs which come to maturity in the two ovaries of a queen-bee are only of one and the same type, which, when they are laid without coming in contact with the male semen, become developed into male bees; but, on the contrary, when they are fertilized by male semen, produce female bees," from which theory, if true, we might, in the words of Von Siebold, "expect beforehand that by the copulation of a unicolorous blackish-brown German and a reddish-brown Italian bee, the mixture of the two races would only be expressed in the hybrid females or workers, but not in the drones, which, as proceeding from unfecundated eggs, must remain purely German or purely Italian, according as the queen selected for the production of hybrids belonged to the German or Italian race," the writer set to work to obtain hybrids between *Apis mellifica* and *Apis Ligustica*, and also between *Apis mellifica* and *Apis fasciata*, and the result of his experiments was that Ligurian queen-bees fertilized by English drones, and Egyptian queen-bees fertilized by English drones, both produced drones which, as well as the workers, were hybrid in their characters, and bore unmistakable evidence of the influence of the male parent. From this the author drew the conclusion that the eggs of a queen-bee which has been fertilized by a drone of another race, whether they develop into drones or workers, are in some way affected by the act of fecundation, and that both sexes of the progeny partake of the paternal and maternal character or race; from which it followed that Dzierzon's was not the true theory of reproduction in the honey-bee. Specimens of the hybrids were exhibited to the meeting; and Mr. F. Smith (who did not consider *Apis Ligustica* to be specifically distinct from *Apis mellifica*), after an examination of the specimens, corroborated Mr. Lowe's statement that the hybrid drones distinctly showed characters peculiar to *Apis mellifica* in combination with the characters which distinguish *Apis Ligustica* and *A. fasciata* respectively.

NATURAL HISTORY MISCELLANY.

ZOÖLOGY.

The Dodo.—Mr. George Clarke, of Mauritius, has discovered a large deposit of bones of the Dodo in the swamp known as the "Marcaux Songes." By this now celebrated discovery the whole skeleton of the Dodo has been made known, excepting the end of its wing; whereas before the head and foot at Oxford, the skull at Copenhagen, the foot in London, and the beak at Prague, were all the specimens known of the bird.—*Quarterly Journal of Science, London.*

Singular Variety of the Field Sparrow.—On the 12th of October, I shot a very singular variety of the Field Sparrow (*Spizella pusilla*) Baird. It was precisely similar to the ordinary form of that bird, except that its tail was pure white; with the exception, however, of the second and third exterior feathers, which were of the usual color. So marked a variety in a bird that generally presents very slight variations in color is so remarkable, that I consider it worthy of especial notice.—T. Martin Trippe.

THE GIGANTIC BIRDS OF THE MASCARENE ISLANDS. — With the Dodo were associated a large Parroquet, the Solitaire, the Géant (*Gallinula gigantea* Schlegel), and the *Porphyrio* (Notornis?) *cærulescens* Schl., which last is as large as a full-sized goose, blue, with the beak and feet red. It could not fly, but ran with great swiftness.

We figure from Schlegel's account in the French Annals of Natural Science, 1866, the "Géant," so called by its discoverer, Leguat, who saw this bird in 1694, since which time it has disappeared. It is allied to the Water Hens, and was six feet high; its body was as large as that of a Goose, white, with a reddish spot under the very small wings.

The "Géant," 1-20 the natural size.

These singular birds characterizing the land fauna of these islands, of which Mauritius is the largest, seem like the gigantic birds of New Zealand, as Schlegel remarks, to have replaced the mammals, of which these two groups of islands are destitute, and thus explains why these most characteristic birds are so peculiar in their size and structure. These birds were destroyed as early as 1700 by the European settlers, the cats and dogs, and the maroon Negroes. The Dodo and Solitaire are figured in Dana's Manual of Geology.

THE EAGLE A FISHER. — The American bald eagle (*Haliâetus leucocephalus*) belongs to the group of fishing-eagles, as might be inferred from the name of the genus, which is derived from *hals* (sea), and *a-et-os* (eagle); whence *Hal-i-a-et-us* (and less properly in science, the poetic form Haliæetus), a name applied to the osprey by the Greeks. The spelling "Haliætus" and the pronunciation "Haliâetus" are erroneous.

The East Indian *H. ponticerianus* is known to be a fisher, and the South African *H. vocifer* is called "the fishing-eagle" at the Cape of Good Hope.

The mode in which the bald eagle pursues and robs the fish-hawk is well known from the description of Alexander Wilson, which has been often quoted, as in the fourth volume (p. 92) of Harper's School and Family Readers, by Marcius Willson, who, however, has interpolated the words "as he is not a fisher himself." In my "Notes on Willson's

Readers" (1864) I state that the bald eagle, "with wings nearly closed, darts headlong into the water for his prey, in the general manner of the fish-hawk."

There was an eagle's nest high up on a large buttonwood (*Platanus*, ignorantly termed sycamore in some localities), on an island in the Susquehanna, about ten miles above Columbia, Pennsylvania, and in sight from my father's house, about a mile distant, where I had abundant opportunities to observe the fish-hawk, and the eagle robbing him; but sometimes failing to secure the fish, because its possessor dropped it before the eagle was near enough to seize it in its fall toward the water or the ground: for in the latter case, which was rare, I have observed the eagle to turn away without attempting to seek the fish on the earth.

When there are no fish-hawks to depend on, the eagle fishes for himself, taking the fish (if I remember rightly) with the feet, and leaving the water with apparent difficulty, and a good deal of flapping, which accords with the habits of the East Indian species. — S. S. HALDEMAN, *Columbia, Pa.*

MICROSCOPY.

STUDENTS' MICROSCOPE. — We call the attention of our readers to the advertisement of the Students' Microscope, manufactured by the Boston Optical Works. The stand is solid and very convenient, while the lenses are excellent. It is the best and cheapest microscope for general use for the physician and beginner in microscopy now in the market.

EXCHANGES.

Dr. Hermann Loew, of Meseritz (Posen), Prussia, is very desirous of obtaining fresh and well-preserved specimens of North American Diptera. They are very necessary for the completion of his work on the North American Flies, now publishing by the Smithsonian Institution. He will send very fine specimens of European Coleoptera to any Entomologist who will furnish specimens of Diptera in exchange. Packages may be sent through the Smithsonian Institution, Washington, D. C.

EXPLORATIONS.

Mr. W. H. Dall, of the Scientific Corps of the Western Union Telegraph Company, Russian Extension, writes from St. Michaels, R. Am., Aug. 14, 1867: "I have travelled in winter, with the thermometer from 8° to 40° with dog sleds and snow-shoes, about 300 miles; and

m the summer just past, I have paddled 650 miles up stream under the scorching northern sun, and 1,300 down stream in open canoes. I have made the first trip from Fort Youkon to the sea by the river Youkon ever made, and have geological notes of the whole of this distance, and have collected about 4,550 specimens, including some 300 or 400 birds and mammals, and have got, I hope, some fine new species of white fish.

ANSWERS TO CORRESPONDENTS.

R. A. S., Wisconsin. — The worm you send came dried up and impossible to identify. It is probably an *Ascaris*, one of the round intestinal worms. Among the best works on the Microscope are Carpenter on the Microscope, published by Lea & Blanchard, Philadelphia; Queckett's Treatise on the Microscope, London; L. Beale's How to Work with the Microscope, Philadelphia; J. Hogg on the Microscope, London; P. H. Gosse's Evenings with the Microscope, New York. D. Appleton & Co.

W. H. S., Hummelstown, Pa. — The shells appear to be robust specimens of *Physa ancillaria*, Say. The "worm-like animals" are the larvæ of the Caddis-fly, or Case-worm (*Phryganea*,) whose larva constructs a case of leaves, or bits of twigs and sticks. The other specimens were young Cray-fish, *Cambarus Bartoni*, commonly found in brooks in the Middle and Southern States. We have found this or an allied species hiding under stones on the edges of cold ponds in northern Maine. On the Aroostook River, they did great damage by undermining a dam, at or near Presque Isle. The Cray-fish has undermined the levee at New Orleans and vicinity, and been instrumental in producing devastating floods on the banks of the Mississippi.

Some spiders have the power of spinning their threads to a great length, which float in the air (the wind drawing the threads from the spinnerets), and catch on adjoining objects, serving as foundations for a web.

A. E., Maryland. — Your Myriapod, which you say "has appeared at this place (Ecton, Md.) within a few years past, and has infested many houses," is the *Cermatia forceps*, Wood. It is found sparingly throughout the Eastern, and especially the warmer parts of the United States. Scarcely anything is known regarding its habits.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—NATURAL HISTORY SECTION. *Burlington, Vt., August* 21–26, 1867. "On the Zoölogical Affinities of the Tabulate Corals." By Professor A. E. Verrill. Coral-like forms were stated to be formed by various kinds of animals, and also by some plants. Thus we have Protozoön corals (*Eozoön*, *Polytrema*, stony sponges, etc.); Molluscan corals (*Bryozoa*); Hydroid corals (*Sertularia, etc.*); Polyp corals (*Gorgonia, Tubipora, Madrepora, etc.*); Vegetable corals (*Nullipora, Corallina*).

Although there are still some doubtful groups of corals, the nature of most forms is now well known. The most important doubtful groups are at present the Cyathophylloid corals (*Rugosa* Edw.), and the Tabulate corals. Nearly all authors place both these great groups among the true Polyps, but a few advocate the Molluscan affinities of some of the Cyathophylloids, and certain genera of the Tabulata (*Chætetes, etc.*), the former being compared with Hippurites, etc., and the latter with Bryozoa.

Professor Agassiz has, however, referred both these groups to the Hydroids, placing them, therefore, in the class of Acalephs. As both are abundant in the Silurian rocks, this generalization carries the appearance of the Acalephs back from the Jurassic to the Lower Silurian period. Therefore this becomes a question of importance both in Geology and Zoölogy. The Cyathophylloid corals being entirely extinct, their real affinities may, perhaps, long remain in doubt. The Tabulata, however, are still represented in tropical seas by several genera and numerous species.

Professor Agassiz examined the living animals of Millepora several years ago at Florida, and in his "Contributions" has figured and described them, showing them to be genuine Hydroids, the different-sized cells being occupied by different sorts of individuals, comparable to the different kinds of individuals in the communities of various other Hydroids. From these observations, upon a single genus, he has concluded that all other Tabulate corals, living and fossil, are also Hydroids. In the hope of throwing some light upon this question, Mr. F. H. Bradley was requested, while collecting at Panama for the Yale College Museum, to examine, if possible, the living animals of a species of *Pocillipora* found at that place, a coral belonging to the Tabulata, but to a family (*Favositidæ* Edw.) differing in many characters from Milleporidæ. According to his descriptions and drawings, the animals of Pocillipora have all the external appearances and structure of a true Polyp, closely resembling those of Porites. They are

exsert when expanded, and have twelve equal cylindrical tentacles surrounding the margin in a single circle, six of them being held horizontally, and the alternating ones erect. This peculiar posture was the principal difference observed between these animals and those of *Porites*, when compared side by side.

From the disagreement in the character of the animals of *Millepora* and *Pocillipora*, in connection with great differences in the corals, it is necessary to refer the former to the Hydroids, while the latter must remain with the true Polyps. It is probable that *Favosites*, and many other extinct tabulated genera belong with *Pocillipora*, while *Heliolites*, etc., may go with *Millepora*. Therefore we must regard the Tabulate structure as a character of secondary importance and the artificial group of *Tabulata* must be dismembered.

"On the Coal Measures of Illinois, with a vertical section of the Strata." By A. H. Worthen, State Geologist. In the prosecution of the Geological Survey of Illinois, it seemed desirable to identify our coal-seams with those of the Kentucky section, inasmuch as the Illinois and Kentucky coal-field was known to belong to the same basin; and with this end in view, a general examination of our coal-measures was made by Professor Lesquereux, and the results were published in the first volume of the Illinois Report. Subsequent investigations showed that the conclusions arrived at in regard to the position that the main coal-seams occupied in the Illinois section, especially those recognized as the equivalents of Nos. 5-9 and 11, of the Kentucky section, were erroneous, and that if that section was correct, no parallelism could be made out between the coal-seams of the two States.

In order to determine correctly the sequence of the coal strata, as they are developed in Central and Northern Illinois, a section was constructed the present season along the valley of the Illinois River, which traverses the coal-field from south-west to north-east, for a distance of about one hundred miles. This section shows the development of six beds of workable coal, together with four or five thin coals, varying from a few inches to two feet in thickness, and the whole are enclosed in about five hundred feet of measures immediately above the conglomerate. This includes all the workable coals at present known in the State. By comparing the Illinois with the Kentucky section, we found a general correspondence in the lower part of each, but nothing in the Illinois section to correspond with the *Anvil Rock Sandstone* and the beds intervening between that and the *Mahoning Sandstone*. Taking these beds from the Kentucky section we have a general agreement between the two. Hence we were led to conclude that in constructing the section in Kentucky, a single

sandstone, outcropping at different localities, had been mistaken for two different beds, to one of which the name of Anvil Rock was given at one locality, while at the other it was called Mahoning Sandstone, and in this way their section was increased in thickness about three hundred feet or more beyond what it really should be, and the number of workable coal-seams nearly doubled.

This view of the case is strengthened by the fact also of a general correspondence between the upper portions of the two sections, both of which are characterized by several thin seams of coal, of little or no value in consequence of the thinness of the strata, while the limestones in this part of the Illinois section are characterized by a group of fossils recognized by Professor Meek as common in the upper coal-measures of Kanzas, and as the equivalent of beds to which the term "*Permo-carboniferous*" was applied by himself and Dr. Hayden in their paper on the rocks of Eastern Kansas.

Again, by placing these sandstones on a parallel, and giving a downward section for three hundred feet as given in the Kentucky section, and we have an almost equal repetition of beds.

If we take the Kentucky section as published, and place these sandstones on a parallel, we find an almost exact repetition of the strata for 300 feet below, and from these facts we are forced to conclude that the Anvil Rock and Mahoning Sandstones are identical, and that the section should be shortened by extracting from it all the strata composing the first-named Sandstone, and the beds supposed to intervene between it and the lower bed. This gives a general correspondence between the Illinois and Kentucky sections, such as might be expected to occur in different portions of the same coal-field.

"On the Lower Silurian Brown Hematite Beds of America." By B. S. Lyman. Some thirty exposures of brown hematite, in Smyth county, South-western Virginia, are found by a rough topographical survey to belong apparently to the outcrops of four ore-beds, conformable to the Lower Silurian rocks of the region. At three or four exposures the solid ore-bed is to be seen; at the others only loose lumps of ore mixed with loam.

The other American brown hematite deposits of the same age, resemble these so closely as to leave the impression that where only loose lumps of ore occur, mixed with loam or other materials, they are always mere rubbish that has been accumulating near the outcrop of regular beds ever since the denudation began; similar to the loose blocks of sandstone near the outcrop of a sandstone bed, or to the coal-dirt of a coal outcrop, or to gold or tin alluvial deposits, making allowance of course in the comparison for the characteristic

hardness and heaviness of the brown hematite, and for the thickness of its beds. The ore lumps would be mixed not only with the rubbish of neighboring rock-beds, but with the remains of plants that grew during the accumulation of the ore-lumps, such as the Brandon and Mont Alto lignites. Lumps of carbonate of iron, found in some such deposits, go towards showing that the ore was originally a carbonate, and afterwards altered as the coal-measure carbonates so often are. The author thought these lumps were not concretions.

"The Winooski Marble of Colchester, Vermont." By C. H. Hitchcock. Rough and polished specimens of a beautiful marble, obtained from localities less than six miles from Burlington, were exhibited. It belongs to the lower part of the Potsdam group, and is a silicious dolomite. It contains nodules of calcite enclosing amorphous silica, which render the stone more difficult to saw than statuary marble. The prevailing color is some shade of red, with variations of white, brown, chocolate, and yellowish tints.

"The Distortion and Metamorphosis of Pebbles in Conglomerate." By C. H. Hitchcock. In this paper the doctrine was advanced that the pebbles of certain conglomerates had been very much distorted since their deposition as a coarse sediment, and that in some the chemical character had been altered by metamorphism, so that fragments, originally an impure limestone or a schist, had become changed into quartz. The process had probably been carried so far in some instances specified, that the original sandstone and conglomerates had been converted into schists, gneiss, and granite. The agents producing these changes were thought to be the chemical action of infiltrating mineral waters intensified by the immense pressure, accompanied by a slight plasticity of the pebbles, perhaps no more than is implied by a thorough warm aqueous interpenetration of the masses. Every case described was in a highly disturbed region, where numerous plications in the strata had been observed. Where it was possible to trace a band of rock from a crumpled to its normal position, it was noticed that in the undisturbed state the mass was simply a loosely cemented coarse gravel, with round pebbles; but where folds abounded, the stones had been indented, flattened, and bent, and the cement had become crystalline. Localities were noticed from Middleton, R. I., Bellingham, Mass., Washington County, Mount Battie, and Sandy River Plantation, Me., East Wallingford, and Plymouth, Vt., the Nagelflue in Switzerland, and the Permian conglomerate in England, etc. The opinions of eminent European geologists in favor of a superinduced distortion were quoted, as well as the experiments of Mr. Sorby, illustrating the greater efficiency of chemical action under pressure.

"The Geology of Vermont." By C. H. Hitchcock. A large geological map of this State was shown, illustrating the great advance of our knowledge of its rocky structure since the publication of the author's map in the Final Report upon the Geology of Vermont in 1861. The additions to our knowledge were largely afforded by the extension southerly of the recent discoveries of the Canadian survey.

"Explanation of a Geological Map of Maine." By C. H. Hitchcock. The author exhibited a large geological map of Maine, prepared from the materials gathered during two years work in the service of the State in 1861, 1862.

Boston Society of Natural History. *October* 2, 1867.—The President exhibited a series of Flint instruments from the Island of Regan, and from Norway and Sweden, consisting of arrow and spear heads, square cut chisels, etc. One was a hatchet with a circular hole for the insertion of the handle, the interior of which was smooth and the diameter uniform. Mr. Rau, the Danish Consul at New York, had shown how these holes might be drilled, by boring half through a paving stone with a rotating broomstick and sand. A few implements representing saws and knives, and one, undoubtedly used as a dagger, but resembling a large spear-point, were among the articles exhibited; most of them were unlike anything found in this country.

Dr. Wyman further gave an account of a recent visit of a party of members of the society to shell-heaps upon Goose Island, in Casco Bay. The objects exhumed were mostly similar to those found at Mount Desert, and described by Dr. Wyman at a previous meeting. Among the most interesting were bones, apparently of the Great Auk, a bird now extinct on our coast.

Mr. Edward S. Morse called attention to the evidences of great antiquity in the shell-heaps upon Goose Island. The deposits consisted of large beds of broken clam-shells, with other species intermixed. Over five hundred square feet of surface had been examined, and the absence of any metal and singular scarcity of stone implements were noteworthy. The heaps, which thickened towards the centre, covered areas of from ten to fifteen feet in diameter, and showed an outcrop on the bank of from two or three to fourteen or fifteen inches in height. Since in many cases heaps of this magnitude had been almost wholly washed away, an extensive erosion of the bank must have taken place since the formation of the deposits. Coupled with this fact, Mr. Morse observed one place where the erosion of the bank had exposed the surface of a rock smoothed and scratched by glaciers, and sufficient time had elapsed to erase nearly all these marks from the hard rock. He also remarked that the shell-heaps appeared to rest on

the primitive soil; the turf covered the heaps to the depth of six or seven inches, while there were no traces of soil below. The land-shells, such as *Helix Sayii, indentata, multidentata*, and others, remains of which were found in the lower portions of the heaps, can only exist in hard-wood growths. The portion of the island where these heaps occur is at present covered with large spruce growth. The Quahog, found plentifully in these heaps, is extremely rare in Maine. Thus we have a change of vegetation, a change of certain species of animals, an evidence of extensive erosion of the banks, an absence of articles that we would be likely to find in deposits of recent formation, all indicating extreme age. Hundreds and perhaps thousands of years may have elapsed since these heaps were commenced. The Danish archæologists regarded similar heaps in Denmark as being older than the stone age — in fact, as among the earliest evidences of the presence of man.

A short discussion ensued upon the probability that the shell-heaps rested upon the primitive soil. Mr. Scudder wished to know what had become of the vegetable mould which must have supported the hard-wood growth, beneath which the land-shells, found at the bottom of the shell-heaps, lived. Dr. Pickering believed that vegetable mould would disappear after the lapse of ages by the action of the elements, and Dr. Jackson spoke of the chemical means by which this could be brought about.

Papers were read by Dr. H. Hagen, Mr. P. R. Uhler, and Mr. S. H. Scudder, on the Dragon-flies of the West Indies.

Lyceum of Natural History. *New York, April* 29, 1867. — Mr. C. F. Hartt gave an account of the glacial phenomena about Rio Janeiro, observed by him while a member of the late Thayer Expedition, from Cambridge, under Professor Agassiz. He dwelt at much length on the glacial phenomena exhibited about Rio, which he traced as far north as Bahia, but which Professor Agassiz has claimed to have seen on the Amazon. "Everywhere," said the speaker, "the gneiss hills are rounded evenly down so as to present all the appearance of '*roches moutonnées*,' and immediately over their surface, and clinging closely to it, is a sheet of quartz pebbles, sometimes large, rounded boulders, more or less thick (occasionally absent), following all the curves of the surface, and sometimes found on slopes where the material could never have been deposited by water, and where it is only held in place by a superincumbent sheet of red sandy clay, very variable in thickness, such as would result from the mechanical grinding up of the gneiss. This clay shows no evidence of the sorting action of water, the felspathic clay, broken quartz grains and mica crystals

being all present. It contains occasional angular and rounded fragments of quartz, sometimes of gneiss or some other material, scattered through it."

This drift-sheet was described as extending from the Sierras down over the tertiary deposits occupying the low grounds along the shore. The speaker mentioned the existence of cretaceous beds near Bahia, some fish remains which he found having been identified as cretaceous by Professor Agassiz, and he spoke of the evidence of recent changes of level along the Brazilian coast. He had examined the stone reefs at Pernambuco, Bahia, St. Cruz, and Porto Seguro, and described them as sea beaches which had been solidified by the lime of sea-shells, and which, having been separated from the shore by the encroachment of the sea, now extend along it like linear walls of rock. At Porto Seguro he discovered quite an extensive reef of coral, which he was able to trace southward to the Abrolhos Islands. This reef he saw at a very low tide exposed off Porto Seguro over an area several miles long. The corals grow up sometimes in isolated clumps like mushrooms, and the natives call them *chaparoens*. He spoke of the interest attaching to a still further exploration of this reef, for it is an entirely new ground, and would certainly afford some new and interesting facts to science. He announced that it was his intention to spend his summer vacation on the Abrolhos, taking with him a party, which he hoped would be fitted out by the new Natural History Section of the Cooper Institute.

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